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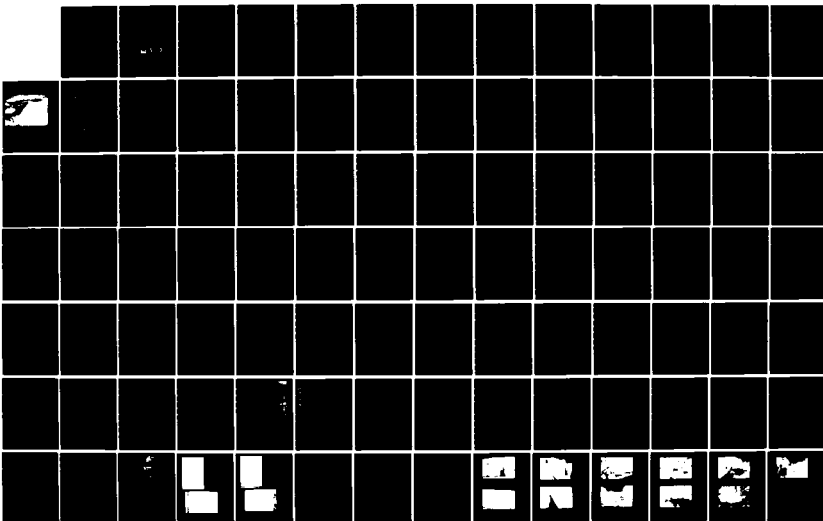
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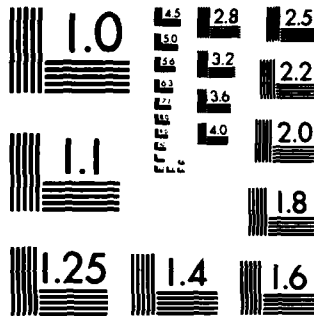
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CONNECTICUT RIVER BASIN
GRANVILLE, MASSACHUSETTS

GRANVILLE RESERVOIR DAM
MA 00707

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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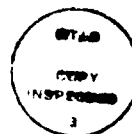
REPLY TO
ATTENTION OF:

NEDED

Honorable Edward J. King
Governor of the Commonwealth of
Massachusetts
State House
Boston, Massachusetts 02133

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Dear Governor King:

Inclosed is a copy of the Granville Reservoir Dam (MA-00707) Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Quality Engineering, the cooperating agency for the Commonwealth of Massachusetts. In addition, a copy of the report has also been furnished the owner, City of Westfield Water Department, Westfield, MA.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Quality Engineering for your cooperation in carrying out this program.

Sincerely,

WILLIAM E. HODGSON, JR.
Colonel, Corps of Engineers
Acting Division Engineer

Incl
As stated

GRANVILLE RESERVOIR DAM

MA 00707

CONNECTICUT RIVER BASIN
GRANVILLE, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.: MA 00707
Name of Dam: GRANVILLE RESERVOIR DAM
Town: GRANVILLE
County and State: HAMPDEN, MASSACHUSETTS
Stream: MUNN BROOK
Date of Inspection: 6 JUNE 1980

BRIEF ASSESSMENT

Granville Reservoir Dam is an earth dam approximately 850 feet long with a maximum hydraulic height of about 106 feet. Embankment height is 92'. The top width of the dam is about 24 feet. The downstream face on the upper half of the dam is a grassed slope of 2H:1V. A 7-foot wide berm traverses the downstream face at an elevation about 45 feet below the top of the dam. Below the berm, the downstream face is a grassed slope of 2½H:1V. The upstream face is riprapped with a slope of approximately 3H:1V. A concrete spillway, with a 1-foot high flashboard and concrete discharge channel, is located at the south abutment. The spillway has a weir length of approximately 60 feet. The concrete end walls for the spillway support a steel truss bridge above. A 42-inch concrete pipe conduit through the dam serves as a low level emergency outlet for the reservoir. A 24-inch water supply main draws water from the reservoir for distribution to the City of Westfield. The reservoir has a normal pool storage capacity of 1660 acre-feet (540 million gallons).

Discharges from the spillway and low level outlet are into the Munn Brook, and then into the Little River. There is no emergency spillway.

Based on engineering judgment and the past performance of the dam and outlet works, the project is considered to be in fair condition at the present time. The project, however, does have a number of deficiencies which, if not remedied, have the potential for developing into serious conditions.

Because the dam is classified as large size and high hazard potential, the test flood is the Probable Maximum Flood (PMF). The PMF inflow for Granville Reservoir, having a drainage area of 5.1 square miles, was estimated to be 9450 cfs. The effects of reservoir storage would cause the routed test flood outflow to be approximately 8300 cfs (with the 42" gate closed) which would overtop the dam by about 1.3 feet at the south end of the dam, and would be about 0.2 feet below the top of dam at the middle of the dam. The capacity of the spillway with water at the low end of the top of dam is 6700 cfs which is about 80 percent of the test flood discharge. The discharge capacity of the 42-inch gate, alone, with water at the top of dam is 280 cfs (or 3% of the test flood discharge). The routed test flood outflow with the 42-inch gate opened would be 8400 cfs. The test flood elevation would be lowered by approximately 0.1' with the 42-inch gate open.

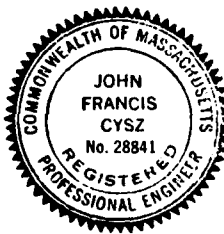
A major breach of the dam could cause appreciable damage to roads and bridges in the downstream area, as well as the loss of Winchell Reservoir which is a small impoundment about 1500 feet downstream. Loss of more than a few lives would also be likely as a result of a dam break.

A number of recommendations and remedial measures are given in Sections 7.2 and 7.3 for implementation by the owner. These recommendations should be implemented within 12 months of receipt of the Phase I Inspection Report, except that design and implementation of repairs to the concrete spillway discharge channel should be done at once. Other recommendations, in general, are as follows:

Engage a qualified Registered Professional Engineer to:

- Investigate the condition of the 42-inch concrete conduit, and evaluate the advisability of operating the conduit under conditions of pressure flow. Design should be made and implemented for repairs to the spillway end walls and backwalls for the spillway bridge, and the cracked back-wall, pier, and pilaster for the control tower service bridge. The engineer should also perform a detailed hydrologic and hydraulic investigation to further assess the need for and means to increase the project discharge capacity.
- Investigate the operability of the 24-inch low level gate valve.
- Supervise the removal of trees and their root systems including the replacement with appropriate materials.

In addition to the remedial measures listed in 7.3, the owner should establish a formal operation and maintenance program, and a formal surveillance and downstream warning (emergency preparedness) program. A qualified Registered Professional Engineer should be engaged to make a comprehensive technical inspection of the dam once a year.



John F. Cysz
John F. Cysz
Project Manager
MA P.E. No. 28841

This Phase I Inspection Report on Granville Reservoir Dam (MA-00707) has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Aramast Mahtesian

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Richard J. DiBuono

RICHARD DIBUONO, CHAIRMAN
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of the Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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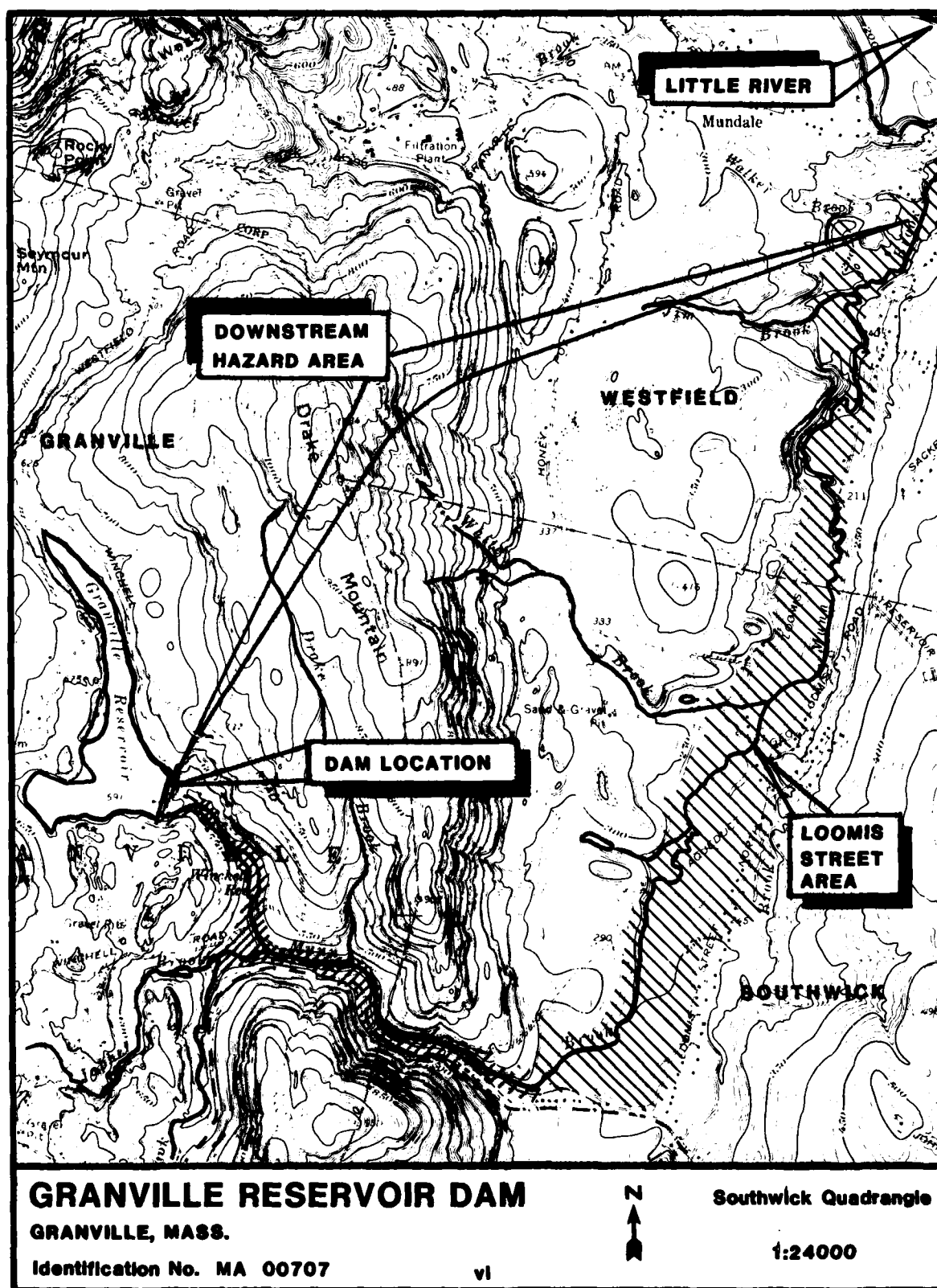
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OVERVIEW OF
GRANVILLE RESERVOIR DAM



NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
GRANVILLE RESERVOIR DAM
SECTION I - PROJECT INFORMATION

1.1 GENERAL

a. Authority

Public Law 92-367, August 8, 1972 authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Robert G. Brown & Associates, Inc. has been retained by the New England Division to inspect and report on selected dams in the Commonwealth of Massachusetts. Authorization and notice to proceed were issued to Robert G. Brown & Associates, Inc. under a letter of 14 March 1980 from William E. Hodgson, Colonel, Corps of Engineers. Contract No. DACW33-80-C-0037 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection

- (1) To perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.
- (2) To encourage and prepare the States to initiate quickly effective dam safety programs for non-Federal dams.
- (3) To update, verify and complete the National Inventory of dams.

1.2 DESCRIPTION OF PROJECT

a. Location

Granville Reservoir Dam is located in the Town of Granville, Massachusetts. The dam is on Munn Brook approximately 5 miles upstream from the brook's confluence with the Little River. The dam impounds Granville Reservoir which is a water supply for the City of Westfield. Granville Reservoir Dam is shown on the USGS Southwick, Mass. - Conn. Quadrangle at Latitude 42° 05.3' and Longitude 72° 50.8. Access to the damsite is from Winchell Road.

b. Description of Dam and Appurtenances

Granville Reservoir Dam is an earth dam, approximately 850 feet long, with a maximum hydraulic height of about 106 feet (measured from the top of dam to the outlet of the 42-inch concrete conduit).

The top of the dam has a width of about 24 feet and is paved with bituminous concrete. The downstream face on the upper half of the dam is a grassed slope of 2H:1V. A 7-foot wide berm traverses the downstream face at an elevation about 45 feet below the top of dam. Below the berm the downstream face is a grassed slope of 2½H:1V. A series of stone-lined ditches run across the downstream face to collect surface runoff and carry it to the toe of the dam in pipe conduits. The upstream face is approximately 3H:1V and is covered with dumped stone riprap (See photographs 1 and 2, Appendix C.) According to available drawings and other records the dam was originally constructed between 1928 and 1929. A permanent monumented baseline and bench mark were established after construction of the dam.

A concrete principal spillway with a single flashboard is located at the south abutment of the dam. The spillway has a weir length of approximately 60 feet. The concrete end walls of the principal spillway support a steel truss bridge above. (See photograph 3, Appendix C.)

The spillway weir discharges into a concrete-lined channel 60-feet wide, with vertical sides and a bottom slope of approximately 9 percent. This channel tapers within about 150 feet to form a transition with a 10-foot wide trapezoidal channel, having ¾H:1V sideslopes, and a bottom slope of approximately 18 percent. The entire spillway discharge channel including the transition is roughly 800 feet. The spillway discharge channel ends at a flare and has a 2-foot high end sill and a cutoff wall. The natural channel beyond the end of the spillway discharge channel is comprised of cobbles, boulders, and debris snags, with trees overhanging the channel. (See Appendix C, Photograph 10.)

A 42-inch concrete pipe conduit through the dam serves as low-level outlet for the reservoir. Two 42-inch gate valves in the control tower at the upstream end of the 42-inch conduit are used only as emergency gates. The valves are located approximately 80 feet below the floor of the control tower. Steel shafts extend from the gate valves up to the floor of the control tower and are connected to floor-stand-mounted geared operators. The gate valves are operated by hand crank. The inlet for the 42-inch conduit is beneath the reservoir approximately 250 feet upstream of the gate valves. Both gate valves for the 42-inch concrete conduit are normally closed.

The 42-inch conduit discharges at a concrete headwall (See Appendix C, Photographs 6 and 7.), approximately 550 feet downstream of the control tower. The control tower which houses the 42-inch emergency gates is reinforced concrete and is about 20 feet wide and 26 feet long at the top (at service floor level). The control tower, including the brick service building, can be seen in Appendix C, Photograph 1.

The control tower also contains the control gates (service gates) for the 24-inch water supply outlet. According to available plans, water may be drawn from the reservoir at depths of approximately 7 feet, 21 feet and 39 feet below the normal surface elevation of 591 on USGS datum (approximately equal to top of 1 foot high flashboard elevation 539 on the 1926 construction plan which was based on the City of Westfield Datum). Each of these 3 inlets

have bar screens, and each inlet is controlled by a gate valve operated from the service floor of the control tower. The inlet at 21-foot depth is normally open, with the others being kept closed.

Water may also be drawn off the reservoir bottom through a 24-inch intake in the event that the water level falls below the normal inlets. This low-level intake is double-gated. There is also an unuseable water supply intake located about 2 feet above the normal water level.

Water to the 24-inch water supply outlet enters a wet well in the upstream half of the control tower. Dry chemicals for water treatment are introduced into the wet well where mixing occurs before being drawn out through the 24-inch water supply outlet. According to the dam operator, water can also be brought into the 24-inch water supply outlet through a 12-inch bypass which has a single valve.

Access to the two 42-inch emergency gate valves and the 24-inch water supply valves is by a steel ladder mounted on the dry well side of the control tower. Valves controlling the inlets into the wet well are accessible by ladder only when all water inlets are closed off, and the wet well is drained.

A steel truss bridge, with wood plank flooring, connects the top of the dam to the service floor of the control tower. This bridge has a design loading of 1 ton. According to the dam operator, no vehicles are allowed on this bridge.

The service building on the control tower formerly housed a chlorinator which has now been removed. A manually-operated crane hoist with a 1-ton capacity is included inside the service building. Openings, with removeable grates in the service floor, allow valves to be hoisted up for maintenance. There is no electrical service to the building although the floor is well-lighted by several windows during the daylight hours.

The dam has a rock toe with a 10-inch drain to collect seepage and allow it to be monitored at a rectangular weir. The weir is contained in a chamber approximately 18 inches wide about 200 feet upstream of the concrete headwall for the 42-inch conduit. All water from the weir chamber discharges through a 10-inch pipe at the concrete headwall for the 42-inch conduit.

A drainage system at the north abutment reportedly intercepts a subsurface spring and is not related to seepage from the rock toe. The activity of this spring (estimated at 4 to 5 gpm) can be observed in a manhole on the downstream face of the dam in an area where the fill slope merges with the northern slope of the valley. A dye tracer test confirmed that the abutment drain discharges about 60 feet downstream of the concrete headwall for the 42-inch conduit. (See General Plan, Appendix B-3.)

A brick building called the "lower gate house" is located about 550 feet downstream of the dam. The lower gate house contains gates which allow the 24-inch water supply outlet between the dam and the lower gate house to be flushed or "blown-off." During flushing, water is discharged through a 24-inch pipe at the headwall for the 42-inch conduit. (See Appendix C, Photographs 6 and 7.) The blow-off system would also allow the 24-inch conduit to act as an emergency outlet.

c. Size Classification

Large (hydraulic height 106 feet; storage 2550 Ac. Ft.) based on height (greater than 100 feet) as given in the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification

The dam is in a high hazard category because a major breach of the dam could cause appreciable damage to roads and bridges in the downstream area. Loss of more than a few lives would be likely. (See Section 5.5)

e. Onwership

The dam is owned by the City of Westfield, Board of Water Commissioners. Overall supervision of the water system is assigned to the Water Superintendent:

Mr. Leonard E. Phelon
City of Westfield Water Department
City Hall
59 Court Street
Westfield, MA 01085
Telephone: (office) (413) 568-9181

f. Operator

The full-time caretaker of the dam has an office in the "Engineers House" at the south abutment of the dam (see Photograph 3, Appendix C).

Mr. Benjamin H. Ciepiela
Westfield Water Department
Old Westfield Road
Granville, MA 01034
Telephone: (office) (413) 357-8811
(home) (413) 568-1646

g. Purpose of Dam

The dam impounds Granville Reservoir which is a water supply for the City of Westfield, Massachusetts. The reservoir provides approximately 2 million gallons of water per day, on the average.

h. Design and Construction History

The dam was originally built between 1928 and 1929 by the City of Westfield, Board of Public Works. The dam was designed in 1926 by Fay Spofford and Thorndike, Consulting Engineers of Boston, Massachusetts. The general contractor was C & R Construction of Boston, Massachusetts. Plans (1 set of blueprints - 14 sheets), specifications, flow hydrographs, and soil samples from

the original test borings are available at the City of Westfield Water Department. Two additional sets of plans and construction correspondence are on file in the City Engineer's office. Early photographs of the dam are also available at the City of Westfield Water Department. The soil samples are stored at the caretaker's office at the damsite.

Repairs were made to the concrete spillway by WPA forces during the 1930's. According to the dam caretaker, the WPA work consisted mainly of repairs to the concrete discharge channel and adjacent slopes, but also included conservation and forestry work on the watershed.

Gunit concrete was reportedly applied to the concrete spillway and concrete discharge channel within the past 15 years. According to the dam caretaker, cement grout was also injected under the floor of the spillway discharge channel which was undermined in certain areas.

The 42-inch concrete conduit was repaired from the inside of the conduit during the early 1970's. Repair to a washout at the end of the spillway discharge channel were also made during the early 1930's; however, this has re-occurred. Plans and specifications have been prepared and bids were received in July 1980 for some repairs to the channel and flashboards.

i. Normal Operating Procedures

A full-time caretaker is assigned to the dam by the City of Westfield Water Department. The caretaker reports to the site daily to observe the water level in the reservoir, record rainfalls, add water treatment chemicals to the wet well in the control tower, and to assist with, and supervise, routine maintenance at the damsite such as mowing slopes, patrolling roads in the watershed, and cleaning ditches. The caretaker's office is located in the building south of the damsite. Telephone, electric and sanitary service is provided for the building. Other responsibilities of the caretaker include operation of the chlorinator and chemical feed equipment, which is located off to the side of the 24-inch water main, in a concrete block building near the Winchell Reservoir site (see location map). According to the caretaker, he also collects daily water samples from the 24-inch water main and tests them for chlorine dosage and turbidity, and is responsible for maintaining the flow meters and recorders.

The 42-inch emergency gates at Granville Reservoir are normally both kept in a closed position. The upstream gate is always kept closed, however the downstream gate is reportedly exercised once a year. The 42-inch conduit was last used in 1955.

The normal reservoir level is maintained approximately 1 foot above the crest of the concrete spillway by use of a wood plank flashboard (see Appendix C, Photograph 3) which is approximately at elevation 591 MSL as shown on the USGS Quadrangle. During periods of low inflow, reservoir evaporation and water supply draft causes the surface level to drop below the flashboard and spillway crest.

Water is drawn through the water supply inlet located 21 feet (middle valve) below the normal water surface. The other two inlets valves are kept closed. The caretaker reports that there are bar screens at all water supply inlets. There are slots for stop logs, but there are no stop logs. The two 24-inch gate valves which allow water to be drawn off at the reservoir bottom are kept closed. One 24-inch gate valve which draws water out of the wet well in the upstream half of the control tower is kept in a fully-open position. The 12-inch bypass is kept closed.

1.3 PERTINENT DATA

a. Drainage Area

The total drainage area contributing to Granville Reservoir is 5.1 square miles. The watershed is drained by two main brooks; Tillotson Brook and Hollister Brook which, under drained reservoir conditions, converge at a point about 200 feet upstream of the control tower. Prior to construction of the dam, the confluence of the two brooks was approximately 200 feet downstream of the dam center line.

The watershed terrain is mainly forested. Elevations vary between 591 MSL at the reservoir to 1455 MSL at Sweetman Mountain at the watershed boundary. Aside from Granville Reservoir, there are no significant water bodies in the watershed. Granville Reservoir has a normal water surface area of 72 acres which is about 2 percent of the total drainage area. Most of the drainage area is owned by the City of Westfield.

b. Discharge at Damsite

Discharge at the damsite is over the 60-foot long concrete spillway which has one wooden flashboard at its crest. A 42-inch conduit is used as an emergency outlet. A 24-inch water supply outlet conveys water to the City of Westfield. According to a 1926 plan on file with the City of Westfield Water Department, the crest of the concrete spillway is at elevation 538.0 (approximately 590 on USGS MSL Datum).^{*} The top of the wood plank flashboard is about elevation 591 MSL as indicated by the normal pool elevation on the USGS Quadrangle. There is no emergency spillway.

- (1) Outlet works - Emergency use only - one 42-inch conduit at elevation 522; discharge capacity 280 cfs @ 600.7 MSL. Capacity of 24" low level outlet is 30 cfs @ 600.7 MSL.
- (2) Maximum flood at damsite - unknown. Water was close to the low end of the top of dam in 1955, but reportedly the dam was not overtopped.
- (3) Ungated spillway capacity at top of dam (low end) 6700 cfs @ 600.7 MSL (low end of dam).
- (4) Ungated spillway capacity at test flood elevation - 8200 cfs @ 602.0 MSL.
- (5) Gated spillway capacity at normal pool elevation - no gated spillway.

^{*} The elevations of the original plans are referenced to the City of Westfield datum which is different than the USGS datum by approximately 52.7 feet. For the purpose of this report, the normal water surface elevation of 591 MSL shown on the USGS Quadrangle was assumed to be the top of the flashboard.

- (6) Gated spillway capacity at test flood elevation - not applicable.
- (7) Total spillway capacity at test flood elevation -
 - 8300 cfs @ 602.0 MSL - without 42" outlet
 - 8400 cfs @ 601.9 MSL - with 42" outlet
- (8) Total project discharge at top of dam - 7030 cfs @ 600.7 MSL.
(Spillway, 42-inch and 24-inch outlets)
- (9) Total project discharge at PMF test flood elevation -
8300 cfs @ 602.0 MSL.
- c. Elevation (Datum is feet above mean sea level NGVD, referred to as MSL in this Report)
 - (1) Streambed at toe of dam - 496 MSL (at headwall for 42" conduit)
 - (2) Bottom of cutoff - unknown (estimated at elev. 508 MSL based on 1926 plans)
 - (3) Maximum tailwater - unknown
 - (4) Normal pool - 591 according to USGS Quadrangle. (Elevation 539 per 1926 plan, based on City of Westfield Datum.)
 - (5) Full flood control pool - not applicable
 - (6) Spillway Crest - 590 (without flashboards)
 - (7) Design surcharge (Original Design) - 596 (with flashboard)
 - (8) Top of dam - 600.7 @ low end, 602.2 average top elevation
 - (9) PMF Test flood surcharge - 602.0
- d. Reservoir (length in feet)
 - (1) Normal pool - 4600
 - (2) Flood control pool - not applicable
 - (3) Spillway crest pool - 4550
 - (4) Top of dam - 4700
 - (5) Test flood pool - 4750
- e. Storage (acre-feet)
 - (1) Normal pool - 1658 (540 million gallons)
 - (2) Flood control pool - not applicable

- (3) Spillway crest pool - 1590
- (4) Top of dam - 2400 @ 600.7 MSL, 2550 @ 602.2 MSL.
- (5) Test flood pool - 2521 @ 602.0 MSL.
- f. Reservoir Surface (acres)
 - (1) Normal pool - 72
 - (2) Flood control pool - not applicable
 - (3) Spillway crest pool - 70
 - (4) Top of dam - 81 @ 600.7 MSL; 84 @ 602.2 MSL.
 - (5) Test flood pool - 84 @ 602.0 MSL.
- g. Dam (no dike)
 - (1) Type - earth embankment/gravity
 - (2) Length - 850 feet
 - (3) Height - 106 feet from average crest elevation to streambed at downstream toe of concrete headwall for 42" outlet.
 - (4) Top width - 24 feet
 - (5) Side slopes - upstream 3H:1V
- downstream 2H:1V upper half, 2½H:1V lower half
 - (6) Zoning - rock toe, covered and vegetated
 - (7) Impervious Core - earth fill only
 - (8) Cutoff - puddled backfill and concrete
 - (9) Grout curtain - unknown, none shown on 1926 plans
 - (10) Other - steel truss bridge over spillway
- h. Diversion and Regulating Tunnel - not applicable (see j)
- i. Spillway
 - (1) Type - concrete with pins for wood plank flashboard
 - (2) Length of weir - 60 feet
 - (3) Crest elevation - 590 MSL without flashboards. 591 MSL with present 1 foot high flashboard.

- (4) Gates - none on spillway
- (5) U/S Channel - Granville Reservoir
- (6) D/S Channel - Natural channel of Munn Brook enters Winchell Reservoir 1500 feet downstream of damsite.

j. Regulating Outlets

- (1) Invert - Invert of 42" emergency conduit at bottom of control tower 522 MSL.
- (2) Size - low level emergency outlet 42"; 24-inch water supply outlet (could also be used as emergency outlet).
- (3) Description - 42-inch outlet is reinforced concrete circular pipe about 550 feet long. Inlet for 42-inch outlet is located beneath the reservoir about 200 feet upstream of the control tower.
 - 24-inch water supply outlet is iron pipe conduit which conveys water to the City of Westfield.
- (4) Control Mechanism - 42-inch outlet is controlled by double-gate valves operated by hand crank from service floor of control tower.
 - 24-inch water supply outlet is described in Section 1.2b.

Note: The 24-inch water supply outlet is equipped with a blowoff. The capacity of the blowoff is estimated to be 30 cfs with water at the top of dam.

SECTION 2 ENGINEERING DATA

2.1 DESIGN

Original contract drawings on fourteen sheets entitled "Board of Public Works, Westfield, MA Water Supply, Granville Storage", prepared by Fay Spofford & Thorndike, Consulting Engineers, Boston, dated December 1926 are on file at the office of the City Engineer, City of Westfield. Another set of plans marked "For Estimate Only" are available at the caretaker's office at the damsite. Locations of soil borings and test pits, as well as soil logs are shown on the plan. Soil samples obtained during the original soil investigations are stored in the caretaker's office.

Monthly average flows were recorded at the confluence of Tillotson Brook and Hollister Brook during the years 1908 through 1918. The highest average monthly flow during this period occurred in March of 1909 which had an average flow of 200 cfs. Complete hydrographs for the entire period of record are included in the above-referenced plans.

No computations were available either from the owner or the present engineering firm of Fay Spofford and Thorndike.

There are presently three lines of stone-lined drainage ditches on the downstream face of the embankment which are approximately parallel to each other and to the 7-foot wide berm. The 1926 plans do not show the two uppermost ditch lines.

Available plans show that soils in the area of the north abutment are generally fine sand and clay with gravel and rock (cobbles and boulders); yellow clay and sand; hard-packed fine yellow sand and a little clay; and hard and compact sand, gravel, rocks, and a few thin streaks of clay were noted between approximate elevation 542 MSL (elevation on datum of plan 490), and the bedrock surface which was assumed during design to be approximately elevation 512 MSL (elevation 460+ on datum of plan) at this location.

The plan information also shows the assumed bedrock surface at the south abutment to be about 537 MSL (elevation 485 on datum of plan). The assumed bedrock surface drops off sharply to about elevation 510 MSL (elevation 458 on datum of plan). This information is shown in Appendix B, Plan Photograph B-4.

2.2 CONSTRUCTION

Construction correspondence and records are available from the City Engineer. Photographs taken just after construction of the dam indicate a borrow pit was located to the northeast of the damsite.

2.3 OPERATION

The caretaker reports to the damsite daily. Records of rainfall at the damsite, flows into the reservoir, and reservoir level are recorded by the caretaker. Records of seepage from the foundation drain are also reportedly maintained. According to the caretaker, the average depth of flow over the weir plate is $\frac{1}{2}$ inches (approximately 20 gpm), and is never more than $\frac{3}{4}$ inches. A permanent monumented baseline and bench mark was established after construction and periodic measurements were made to monitor movements in the dam. According to the caretaker no measurements have been made recently.

Routine operations at the dam include daily addition of water treatment chemicals into the control tower wet well section. Vegetation on the downstream slope is cut during the summer months and the stone-lined drainage ditches and catch basins for the surface drainage on the downstream slope are cleaned out. The upstream 42-inch gate valve is kept in a closed position and is not operated. The downstream 42-inch valve is reportedly exercised annually. Valve stems and stem guides for all valves in the control tower dry well section are reportedly brushed and greased annually.

2.4 EVALUATION

a. Availability

Existing information was made available by the Massachusetts Department of Public Works, District 2, the City of Westfield Water Department and City Engineer, and the Hampden County Commissioners. Information from Fay Spofford and Thorndike was not available.

b. Adequacy

The final assessments and recommendations of this investigation are based primarily on the visual inspection, hydraulic and hydrologic calculations, past performance history, and sound engineering judgment.

c. Validity

In general, the information obtained from available plans, previous inspection reports, and sketch information prepared by the Massachusetts Department of Public Works is consistent with observations made during the inspection and is therefore considered reliable.

SECTION 3
VISUAL INSPECTION

3.1 FINDINGS

a. General

Granville Reservoir Dam was inspected on June 6, 1980. The weather was clear and sunny, temperature 65°F. The water level of the reservoir was at elevation approximately 591.0, or at the crest of the 12-inch flashboard. The entire downstream face and toe of the dam, spillway and spillway discharge channel were visible during the inspection. The upstream face of the dam could only be viewed above the noted water level. The two 42-inch gates valves were both closed. The dam caretaker could not open the 42-inch gates without authorization from his supervisor; therefore it is not known if the gates could be opened during an emergency. The intake structure for the 42-inch outlet and the bottom level 24-inch water supply outlet is beneath the reservoir about 200 feet upstream of the control tower and was not visible. It was reported that 24" gate was operable but this is questionable because of the condition of the shaft.

b. Dam

The downstream face of the embankment appears in good condition, with no evidence of sloughing, erosion or slope trespass. More than 12 animal burrows were noted at random locations over the downstream face. The downstream face of the dam is covered with dense vegetation which appears to be about 15% clover. Patches of ferns were noted, particularly near the north abutment. A stand of trees is growing at the downstream toe of the embankment about at the center.

The pavement at the top of the dam is raveled in areas (See Appendix C, Photograph 1), and is in need of maintenance.

The stone-lined ditches which traverse the downstream face are in good condition. A minor amount of sediment was observed in the catch basins which collect drainage from the stone-lined ditches. The dam caretaker reported that the ditches and catch basins are cleaned annually.

Elevations taken on the top of the dam indicate that the south end of the dam is approximately 1.5 feet lower than the center of the dam as measured at the service bridge to the control tower. This indicates that there is camber in the top of the dam to allow for settlement. The 1926 plans show a 2-foot design camber in the top of the dam.

Toward the north end of the dam the top elevation rises to meet a road which passes along the northeast shore of the reservoir. (See location map) The top of the dam is graded to drain toward the upstream face.

The foundation drain was observed to be flowing at a depth of $\frac{1}{2}$ inch over a rectangular weir plate. This flow was estimated to be about 20 gallons per minute, which does not seem to be an excessive amount of seepage for this type of structure. The surface drainage ditches which drain into the sides of the chamber housing the weir require cleaning.

A spring at the north abutment drains into a catch basin and was observed to be flowing at about 4 to 5 gallons per minute. (See General Plan in Appendix B-3.) A dye tracer test indicated that the discharge from this spring is carried by pipes and ditches to the outlet channel about 60 feet downstream of the concrete headwall for the 42-inch conduit.

Riprap on the upstream face is in good condition and is clear of any heavy brush growth.

c. Appurtenant Structures

A concrete spillway is located at the south abutment. The spillway weir is 2 feet wide, 2 feet high and 60 feet long. It has an upstream slope of 2V:12H and a downstream slope of 1V:2H. The crest of the spillway is provided with a 1-foot high wood plank flashboard supported by pipes inserted into sleeves in the concrete. The left end of the flashboard is cracked and leaning forward which causes unequal flow over the flashboard. The flashboard should be replaced. The concrete endwalls for the spillway are approximately 10.7 feet higher than the spillway crest and serve as abutments for a steel truss bridge which passes over the spillway approach channel. The spillway crest is located approximately 20 feet downstream of easterly side of the bridge. The concrete end walls were reportedly treated with gunite concrete within the last 15 years. This gunite is cracked and loose and is on the verge of falling off over large areas. Drain holes near the base of the spillway end walls are constricted by gunite concrete and there is evidence that some drains may have been sealed during the gunite operation. The drains should be cleaned and an effort should be made to find any drains that may have been plugged.

The seats and backwall for the spillway bridge are in need of maintenance. Both of the backwalls show deep spalling and visible reinforcing steel. The expansion joints at the ends of the bridge require cleaning so that the bridge may freely expand without applying lateral forces to the abutment. A crack was noted on top of the right bridge abutment approximately 5 feet upstream of the west side of the bridge. This is near a point where the abutment turns 90 degrees at the inlet to the spillway approach channel. This crack begins about 2 feet downstream of the upstream corner, runs diagonally across the top of the abutment for about 26 inches at an angle of about 45°. On the top of the wall, this crack is approximately $\frac{1}{4}$ " wide and has an open depth in excess of 8 inches (as penetrated with a ruler). The downstream face shows about $\frac{1}{4}$ inch of displacement; that is, the downstream portion of the wall has moved outward at the crack a distance of about $\frac{1}{4}$ inch (see Appendix B-3, Figure 1). This crack should be monitored to determine if there are continuing movements in this wall. The crack should also be sealed to prevent entry of surface water. A number of smaller cracks in the same area should also be sealed.

The steel truss bridge is rusted, in particular on the lower chord members. A thorough scraping, sandblasting and painting of the structure should be done by the owner to maintain the strength of the bridge.

A stone training wall upstream of the spillway bridge directs water into the spillway approach channel along the south shoreline. This training wall is tipped and has fallen over in some sections. The wall should be repaired to prevent undercutting of the slope.

Sections of the concrete bottom of the discharge channel within the middle-third of the transition length, downstream of the spillway weir, are

cracked and have areas of deep spalling and hollow sounding concrete. This condition needs to be investigated by the owner in order to insure that the channel floor is not undermined. According to the caretaker, the channel floor has been undermined in the past and grout was injected through drill holes in the floor to fill the voids. Evidence of the old drill holes are still visible in certain areas.

The joints between the concrete walls of the spillway discharge channel and the concrete floor are open (1" or more) along much of the channel length. Repairs to the discharge channel should include sealing the joints between the channel walls and the floor. Brush and roots growing out of the open joints should be removed.

Approximately 150 feet upstream from the end of the spillway discharge channel, the concrete floor has uplifted for a section of about 40 feet. Protruding reinforcing steel is visible in this area and large pieces of concrete are broken and displaced. (See Appendix C, Photograph 9.) These obstructions have caused discharge flows to leave the channel and wash out an area behind the concrete channel lining. Although it appears much of the concrete discharge channel in this area is founded on rock, rebuilding of the channel and repair of eroded banks will be required in the damaged area.

The control tower is in generally good condition with the exception of the wood planking which covers the water supply inlet area at the outside rear of the building. Some of the planks are decayed and require replacement. There is spalling of concrete on the outside of the control tower above the waterline. Inspection of the dry well section of the control tower indicated efflorescence and minor seepage along the horizontal joints. No serious leakage, joint misalignment or exposed steel was noted on the inside walls of the dry well.

The steel shafts extending from the bottom of the dry well to the service floor of the control tower are rusted and need routine maintenance, and one of the shafts for a valve on the 24-inch water supply outlet is bent. A packing on one of the 24-inch water supply outlet valves was leaking from the top at a rate estimated to be about 2 to 3 gallons per minute. It appears from the plan that a 6-inch valve on the side of the 42-inch inlet serves as a drain at the bottom of the dry well.

The steel access ladder located on the upstream side of the drywell is sound and secure but should be painted as part of routine maintenance to retard rusting in the damp environment.

The steel truss service bridge, with wood plank flooring between the dam and the control tower, is in need of maintenance and a section of the rails require strengthening. The bridge seat requires removal of soil and weathered concrete. The entire steel structure should be scraped and painted, particularly near the bridge seat. The bridge backwall and one of the concrete piers was noted to be cracked. One of the pilasters was also noted to be cracked where the bridge is supported at the control tower.

The 550-foot long 42-inch conduit was inspected from inside. Flow in the bottom of the conduit was estimated to be less than 5 gallons per minute.

The 42-inch gates at the control tower appear to be tightly sealed with no significant leakage visible. Both the horizontal and vertical alignment of the conduit are uniform between the concrete headwall at the outlet of the 42-inch conduit and a point roughly 150 feet downstream of the control tower. The conduit then deflects slightly and rises to the control tower. This deflection appears to be an "as-built" condition and not the result of subsequent movements.

The 42-inch conduit is constructed of poured concrete half sections with joints at about 8 or 10 foot intervals. According to the construction plans, 12-inch high by 12-inch thick anti-seep collars were constructed at 30 foot intervals along the 24-inch and 42-inch conduits. Minor seepage was noted, generally, along the horizontal construction joint between the two half sections. Approximately 450 feet upstream from the headwall, leakage estimated to be less than 1 gpm was noted from a vertical joint in the pipes.

Areas of exposed cobble aggregates, or possibly thin walls, were noted on the interior of the pipe. Several small diameter steel pipes, with caps, were also noted on the interior of the 42-inch conduit primarily near the bottom. Previous concrete patches on the interior walls of the 42-inch conduit were noted.

The headwall for the 42-inch outlet (about 550 ft. downstream from the dam) is in good structural condition, although surface weathering of the concrete was noted. (See Appendix C, Photograph 7.) Two additional pipes exit at the headwall. The middle pipe is the discharge from the foundation drain weir chamber. The other is the discharge for the water supply blow-off. Inside the lower gate house are the gate operators for the blow-off on the 24-inch water supply outlet. The lower gate house is fully accessible and in good condition although vandals have broken some windows in the structure.

d. Reservoir Area

The shoreline of Granville Reservoir is undeveloped. No active recreation use is permitted. The shoreline along the south abutment is mowed down to the water line in the area of the caretaker's building. The dam caretaker reports that the water in the reservoir is 85 feet deep in an area about 300 feet upstream of the control tower. No islands or sediment deposits were observed.

e. Downstream Channel

The channel below the concrete headwall for the 42-inch outlet joins the spillway discharge channel about 250 feet downstream of the lower gate house. Below this juncture the natural channel is comprised of cobbles, boulders and debris snags with trees overhanging the channel. The channel enters Winchell Reservoir about 1500 feet downstream of the damsite. Winchell Reservoir is a small impoundment having a surface area of less than 2 acres and a dam height of about 15 feet. (See Appendix C, Photograph 11.)

3.2 EVALUATION

Visual observations made during the course of the investigation revealed several deficiencies which, at present, do not adversely affect the adequacy of the dam. However, these deficiencies do require attention and should be corrected before further deterioration leads to a hazardous condition. Recommended measures to improve these conditions are given in Section 7.

The major deficiencies noted during the investigation are, in general:

- Presence of several animal burrows on the downstream face of the dam, the deteriorating pavement at the top of the dam, and large trees at the downstream toe.
- Deteriorating concrete, mainly the old gunite repairs at the spillway end walls. The gunite concrete has restricted and possibly plugged drains near the base of the walls.
- Poor condition of bridge seats, backwall, and expansion joints for steel truss bridge over spillway. Critical members in the bridge, in particular the lower chord members, are rusted and in need of maintenance. A crack was noted in the south bridge abutment.
- The stone training wall upstream of the spillway approach channel is tipped and partly fallen over.
- Deteriorated concrete, open joints, and undermining in the spillway discharge channel. A section of the concrete channel lining near the end of the discharge channel has failed due to uplifted floor sections.
- Rusting and bent shafts for gate valves in the dry well of the control tower require maintenance.
- Decayed wood planking over the bar screens for the water supply inlets on the outside of the control tower.
- Cracked backwall, cracked pier and cracked pilaster for steel truss service bridge connecting dam with service floor of control tower. Steel members are badly rusted, particularly at bridge seat.
- There may be thin wall sections or weak joints in the 42-inch concrete conduit which may not be capable of sustaining pressure flows in the conduit. This condition requires further investigation as to the advisability of operating the 42-inch conduits.

SECTION 4
OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 OPERATIONAL PROCEDURES

a. General

Operational procedures for the project are not formally established but are based on the experience of the operating personnel.

b. Description of any Warning System in Effect

There is no formal warning system in effect. The dam is visited daily, including weekends and holidays, by the Westfield Water Department personnel. Telephone service is available in the caretaker's building.

4.2 MAINTENANCE PROCEDURES

a. General

There is no formal maintenance manual for the project. Maintenance is carried out as needed.

b. Operating Facilities

Vegetation is cut from the downstream face and toe area at least once a year. The unpaved portion of the dam is mowed several times each summer.

The stone-lined ditches along the downstream face of the dam and the catch basins are cleaned annually.

Flow over the weir for the foundation drain is observed routinely.

The downstream gate valve for the 42-inch conduit is reportedly exercised annually. The upstream 42-inch gate valve is not exercised.

Recent measurement on the dam, referenced to the monumented baseline and bench mark, have not been made although measurements have been taken in the past.

4.3 EVALUATION

A formal written operational and maintenance plan, including an annual comprehensive technical inspection by a qualified Registered Professional Engineer, should be developed to insure that problems that are encountered can be remedied within a reasonable period of time. A formal written surveillance and downstream warning (emergency preparedness) plan should be established for this structure.

SECTION 5 EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 GENERAL

The total drainage area contributing to Granville Reservoir is 5.1 square miles. The watershed is drained by two main brooks - Tillotson Brook and Hollister Brook.

The watershed terrain is rolling and is mainly forested. Elevations vary between 591 MSL at the reservoir to 1455 MSL at Sweetman Mountain at the watershed boundary. Aside from Granville Reservoir, there are no significant water bodies in the watershed. Granville Reservoir has a normal water surface area of 72 acres which is about 2 percent of the total drainage area.

5.2 DESIGN DATA

The dam at Granville Reservoir was constructed between 1928 and 1929. The design surcharge was about 5 feet above the concrete spillway crest.

Monthly average flows were recorded at the confluence of Tillotson Brook and Hollister Brook during the years 1908 to 1918. The highest average monthly flow during this period occurred in March of 1909, which had an average flow of 200 cfs.

5.3 EXPERIENCE DATA

According to the caretaker of the dam, water rose to a level close to the top of dam (low end) in August of 1955, but the dam was not overtopped. The 42-inch emergency gates were reportedly open during the 1955 flood.

5.4 TEST FLOOD ANALYSIS

Granville Reservoir Dam is classified as large size, having a hydraulic height of 106 feet, and a top of dam storage of 2,400 acre-feet. The dam was determined to have a high hazard classification. Using the Recommended Guidelines for Safety Inspection of Dams, the test flood is the Probable Maximum Flood (PMF).

The Probable Maximum Flood (PMF) was estimated using methods contained in Preliminary Guidance for Estimating Maximum Probable Discharges in Phase I Dam Safety Investigations, issued by the New England Division Corps of Engineers. The curve for rolling terrain was used to determine the test flood inflow.

The PMF test flood inflow from the 5.1 square mile drainage area was estimated to be 9450 cfs. The test flood routing was begun with the water surface at the normal pool elevation (591 MSL). Storage effects would reduce the routed test flood outflow to 8300 cfs.

During test flood conditions water would rise to elevation 602.0 which is about 0.2 feet below the average top elevation of the dam, and about 1.3 feet above the low end of the dam. Water would be passing over the spillway at a depth of 12.0 feet and at a flow rate of about 8000 cfs. Spillway capacity at the top low end of the dam (600.7 MSL) is 6700 cfs which is 80 percent of the test flood discharge.

In the analysis it is assumed that the 42-inch outlet is closed. The discharge capacity of the outlet is approximately 280 cfs at the test flood elevation. This is only 3 percent of the test flood discharge. The routed test flood outflow with the 42-inch gate opened is approximately 8400 cfs. The test flood elevation under these conditions is approximately 601.9 MSL.

The $\frac{1}{2}$ PMF inflow of 4725 cfs was routed with the water surface at normal pool elevation (591 MSL). Storage effects of the reservoir reduce the routed $\frac{1}{2}$ PMF outflow to 4,200 cfs at an elevation of approximately 597.8 MSL.

5.5 DAM FAILURE ANALYSIS

The impact of failure of the dam was assessed using Corps of Engineers "Rule of Thumb" Guidance for Estimating Downstream Dam Failure Hydrographs. The estimate assumes:

- (a) the reservoir surface is at the top of the dam at the time of the breach, and
- (b) a breach of 40% of the dam length at mid-height occurs (160 feet).

The estimated discharge resulting from the breach would be approximately 300,000 cfs. Winchell Reservoir Dam which forms a small impoundment about 1500 feet downstream would likely be washed out. At a road crossing 3.1 miles downstream at Loomis Street, the breach would cause a flood-wave height of about 10 feet. Approximately 10 homes in this area would be subject to flooding at depths of 5 to 10 feet. In all, approximately 30 homes could be severely damaged, or destroyed. Within the 5 miles between the damsite and the point where Munn Brook enters the Little River, the loss of more than a few lives would be likely. It was noted that the downstream area is becoming increasingly developed.

SECTION 6 EVALUATION OF STRUCTURAL STABILITY

6.1 VISUAL OBSERVATIONS

The deficiencies described in Section 3 require attention, and recommendations to correct these deficiencies are given in Section 7.

The most significant visual observation was the condition of the concrete spillway discharge channel which is deteriorating. A portion of the concrete floor near the end of the channel has failed due to uplifting. Other areas of the concrete channel nearer the dam have cracks in the floor with hollow-sounding concrete indicating undermining. Joints between the walls and floor of the concrete channel are opened which allows water to enter behind the concrete.

Several animal borrows were noted on the downstream face of the dam.

The 42-inch concrete conduit is comprised of poured half sections with possible areas of thin pipe walls and non-watertight joints. This condition requires further investigation to evaluate the advisability of operating the conduit under pressure flow conditions.

6.2 DESIGN AND CONSTRUCTION DATA

No design computations pertaining to the structural stability of the dam have been located, but may be in a massive set of files in the office of the City of Westfield Engineer. Plans dated December 1926 are on file with the City of Westfield Water Department and with the City Engineer. Soil samples obtained from the original soil borings and test pits are stored in the caretaker's building at the damsite.

6.3 POST-CONSTRUCTION CHANGES

There does not appear to have been any major post-construction changes. The 1926 plans show only one ditch line on the downstream slope; however, there are three lines of ditches which traverse the slope. The drain which intercepts a spring at the north abutment was apparently installed as a result of a condition discovered during construction. A low retaining wall along the south side of the spillway discharge channel is not shown on the 1926 plans. This work was reportedly done by the WPA in the 1930's.

6.4 SEISMIC STABILITY

The dam is located in Seismic Zone No. 2, and in accordance with Recommended Phase I guidelines does not warrant seismic analysis.

SECTION 7
ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Condition

Phase I investigation of Granville Reservoir Dam does not indicate conditions which would constitute an immediate hazard to human life or property. Based on engineering judgment and the past performance of the dam and outlet works, the project appears to be in fair condition. The project, however, does have a number of deficiencies which, if not remedied, have the potential for developing into serious conditions.

b. Adequacy of Information

Available design and construction data cited in previous sections were reviewed, including previous inspection reports prepared by the Massachusetts Department of Public Works.

The assessment of this dam is based primarily on the visual inspection, past performance history and sound engineering judgment.

c. Urgency

The recommendations made in 7.2 and 7.3 should be implemented by the owner within one year after receipt of this Phase I Inspection Report, except as noted.

7.2 RECOMMENDATIONS

The owner should engage a qualified Registered Professional Engineer to:

- (1) Design repairs to the concrete spillway works including the end walls for the spillway, backwalls of the spillway bridge and spillway discharge channel. The cracked abutment (right side) for the spillway bridge should be sealed to prevent entrance of water and should be monitored for continuing movement. The engineer should evaluate the need to replace the abutment.
- (2) Perform a detailed hydrologic and hydraulic investigation to further assess the need for and means to increase the project discharge capacity.
- (3) Design repairs to the cracked backwall, cracked pier, and cracked pilaster for the steel truss service bridge connecting the dam with the service floor of the control tower.
- (4) Investigate further and evaluate the condition of the 42-inch poured concrete conduit and evaluate the advisability of operating the 42-inch conduit under conditions of pressure flow.
- (5) Investigate the operability of the 24-inch low level gate valve.
- (6) Supervise the removal of trees and their root systems including the replacement with appropriate materials.

The owner should carry out all the recommendations made by the Engineer.

7.3 REMEDIAL MEASURES

a. Operation and Maintenance Procedures

The owner should implement the following remedial measures:

- (1) Control population of burrowing animals on the downstream face of dam and fill in all existing burrows.
- (2) Repair pavement at top of dam.
- (3) Repair area of erosion adjacent to spillway discharge channel (see Appendix C, Photograph 9), pending outcome of recommendations of engineer's study.
- (4) Remove accumulated soil and weathered concrete from the bridge seats on both the spillway bridge and control tower service bridge. The steel bridge members should be cleaned and painted. Rails on the control tower service bridge should be strengthened, and decayed floor planking should be replaced.
- (5) Replace decayed or missing wooden planks over the bar screens for the water supply inlets on the outside of the control tower and on bridge.
- (6) Clean and grease all fittings and guides on valve shafts in the control tower dry well.
- (7) Relay stone training wall upstream of the spillway approach channel.
- (8) Locate, clean all drains at or near the bottom of the spillway and walls.
- (9) Surface drains leading into the manhole containing the weir for the foundation drain should be cleaned. All drains should be accurately mapped.
- (10) Prepare a formal written operation and maintenance plan including an annual comprehensive technical inspection by a qualified Registered Professional Engineer.
- (11) Prepare a formal written surveillance and downstream warning (emergency preparedness) plan.
- (12) Since a permanent monumental baseline and bench mark have been established, periodic measurements should continue to be made as in the past.

7.4 ALTERNATIVES

There are no practical alternatives to the above recommendations.

APPENDIX A

VISUAL INSPECTION CHECKLIST

VISUAL INSPECTION PARTY ORGANIZATION

NATIONAL DAM INSPECTION PROGRAM

DAM: Granville Reservoir MA 00707

DATE: 6 June 1980

TIME: 8:30 a.m.

WEATHER: Sunny 65°F

W.S. ELEV. 591 U.S. 497 DN.S.

ELEV. DATUM: Elevation 591 MSL - Normal surface level (Top of flash-boards) taken from USGS Quadrangle - not by survey.
Estimated 1 foot accuracy

INSPECTION PARTY:

1. J. F. Cysz, P.E.
2. K. N. Hendrickson, P.E.
3. J. E. Walsh, P.E. (Baystate Environmental Consultants, Inc.)
4. L. D. Zwingelstein
5. H. T. Shumway
6. _____

NOTE: Interior of 42" conduit inspected by J. F. Cysz & L.D. Zwingelstein. Dry well of control tower inspected by all party members.

OTHERS PRESENT DURING INSPECTION:

1. Ben Ciepiela (Caretaker - City of Westfield Water Dept.)
2. _____
3. _____
4. _____

VISUAL INSPECTION CHECKLIST

DAM: Granville Reservoir MA 00707

DATE: June 6, 1980

AREA EVALUATED

CONDITION

DAM EMBANKMENT

Note: Elevations referenced to normal water surface 591 MSL per USGS Quadrangle.

Crest Elevation	Definite camber by design - 602.2 MSL (average)
Current Pool Elevation	591 just below flashboard crest
Maximum Impoundment to Date	1955 near crest, but not overtopped
Surface Cracks	None visible
Pavement Condition	Road pavement poor - slopes not paved
Movement or Settlement of Crest	Yes - designed with camber to allow for settlement
Lateral Movement	None visible
Vertical Alignment	OK
Horizontal Alignment	OK
Condition at Abutment and at Concrete Structures	Spillway and walls weathered beneath bridge - gunite repair failed, aggregates exposed, cracking of concrete
Indications of Movement of Structural Items on Slopes	None detected
Trespassing on Slopes	Animal burrows (more than 12)
Vegetation on Slopes	Downstream slope only - 15% clover - good condition. Dampness near fern patches near north abutment area of spring.
Sloughing or Erosion of Slope Abutments	None detected
Rock Slopes Protection - Riprap Failures	Heavy riprap on upstream slope - good condition.

VISUAL INSPECTION CHECKLIST

DAM: Granville Reservoir MA 00707

DATE: June 6, 1980

AREA EVALUATED	CONDITION
<u>DAM EMBANKMENT</u> (cont'd.)	
Unusual Movement or Cracking at or near Toes	None detected
Unusual Embankment or Downstream Seepage	No - $\frac{1}{2}$ " over weir for foundation drain reported normal
Piping or Boils	No
Foundation Drainage Features	OK - Rock toe with collector drain monitored at weir
Toe Drains	OK
Instrumentation System	Weir - clean out manholes; routine maintenance required for catch basin ditches.

VISUAL INSPECTION CHECKLIST

DAM: Granville Reservoir MA 00707

DATE: June 6, 1980

AREA EVALUATED

CONDITION

OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE

Not visible below water level

a. Approach Channel

Located 200' upstream of control tower.
Intake is for 42" conduit and 24"
bottom level water supply outlet which
is not used.

Slope Conditions

Bottom Conditions

Rock Slides or Falls

Log Boom

Debris

Condition of Concrete Lining

Drains or Weep Holes

b. Intake Structure

Not visible

Condition of Concrete

Stop Logs and Slots

VISUAL INSPECTION CHECKLIST

DAM: Granville Reservoir MA 00707

DATE: June 6, 1980

AREA EVALUATED

CONDITION

OUTLET WORKS - CONTROL TOWER

a. Concrete and Structural	OK
General Condition	Maintenance required
Condition of Joints	Construction joints - OK
Spalling	None on inside. Spalling above water line on outside of control tower.
Visible Reinforcing	No
Rusting or Staining of Concrete	No
Any Seepage or Efflorescence	Yes - on inside walls of dry well
Joint Alignment	Good
Unusual Seepage or Leaks in Gate Chamber	Packing leaking on 24" valve
Cracks	None visible
Rusting or Corrosion of Steel	Valve shafts rusted. One valve shaft bent; maintenance required.
b. Mechanical and Electrical	No electrical
Air Vents	None
Float Wells	None
Crane Hoist	Yes - 1 ton capacity
Elevator	None
Hydraulic System	None - all manual valves
Service Gates	One valve has bent shaft
Emergency Gates	42" with double-gate valves. Conduit not used since 1955 - exercise downstream valve once a year. Not opened during inspection.

VISUAL INSPECTION CHECKLIST

DAM: Granville Reservoir MA 00707

DATE: June 6, 1980

AREA EVALUATED

CONDITION

OUTLET WORKS - CONTROL TOWER (cont'd.)

Lightning Protection System No

Emergency Power System No

Wiring and Lighting System in Gate Chamber Portable generator available if needed

VISUAL INSPECTION CHECKLIST

DAM: Granville Reservoir MA 00707

DATE: June 6, 1980

AREA EVALUATED

CONDITION

OUTLET WORKS - TRANSITION AND CONDUIT

Inspected by walking up inside of conduit about 500 feet. Early 1970's pipe repaired from inside.

General Condition of Concrete

Conduit made of poured half sections - areas of exposed cobble aggregates.

Rust or Staining on Concrete

Yes; also efflorescence at joints including horizontal construction joints.

Spalling

Exposed cobble aggregates in small areas

Erosion or Cavitation

No

Cracking

None detected

Alignment of Monoliths

Not applicable

Alignment of Joints

OK

Numbering of Monoliths

Station marks on side of conduit

Note: Gate valves appear tight. Seepage into pipe at joint where pipe was poured in half sections. No pressure leakage noted. Seepage only along entire 550' of pipe. Sections of pipe have areas of exposed cobble aggregates. 1970 patches are visible.

Capped relief pipes noted in bottom and sides of pipe. Alignment, H & V appear good. Pipe takes bend about 75' downstream of Control Tower.

VISUAL INSPECTION CHECKLIST

DAM: Granville Reservoir MA 00707

DATE: June 6, 1980

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL</u>	Includes headwall at outlet of 42" conduit.
General Condition of Concrete	Satisfactory - stability good
Rust or Staining	Minor
Spalling	Yes - surfaces weathered (see photograph)
Erosion or Cavitation	Surface weathering only
Visible Reinforcing	No
Any Seepage or Efflorescence	No
Condition at Joints	OK
Drain Holes	No - blowoff outlet and outlet from foundation drain also exit at headwall.
Channel	There also seems to be a pipe beneath channel at outlet of 42" conduit.
Loose Rock or Trees Overhanging Channel	Yes - beyond point where spillway discharge channel joins.
Condition of Discharge Channel	OK between headwall and spillway discharge channel. Brush cut annually.
<p>Note: Flow from spring at north abutment drains to a culvert about 60 feet downstream of headwall as evidenced by dye test.</p>	

VISUAL INSPECTION CHECKLIST

DAM: Granville Reservoir MA 00707

DATE: June 6, 1980

AREA EVALUATED

CONDITION

OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS

Low stone masonry training wall along shore side unstable - falling over.

a. Approach Channel

General Condition

Good

Loose Rock Overhanging Channel

Yes - low stone masonry training wall

Trees Overhanging Channel

None

Floor of Approach Channel

OK - few 10" - 12" rocks

b. Weir and Training Walls

General Condition of Concrete

Spillway Crest satisfactory. Concrete end walls have weathered surfaces.

Rust or Staining

Yes - at bridge seats and backwall

Spalling

Yes - mainly gunite repairs falling off

Any visible reinforcing

Yes - backwalls of bridge over spillway

Any Seepage or Efflorescence

Yes - along cracks in old gunite (see photograph).

Drain Holes

Yes - at spillway end walls. Drains about 1 foot deep, 2" diameter; 2 on dam side - 4 on shore side. Some plugged by gunite.

c. Discharge Channel

General Condition

Fair - cracked and possible undermining in transition. Old grout holes in floor noted.

Loose Rock Overhanging Channel

No

Trees Overhanging Channel

1 sapling - roots should be removed in channel.

Floor of Channel

Uplifted, cracked gunite spalling; hollow sounding areas; open joints between floor and walls.

VISUAL INSPECTION CHECKLIST

DAM: Granville Reservoir MA 00707

DATE: June 6, 1980

AREA EVALUATED

CONDITION

OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS (cont'd.)

Other Obstructions

Portion of uplifted floor 150' from end of discharge channel. Debris at spillway removed frequently by Water Department personnel.

Note: Backwalls for spillway need repair-rebars visible bridge at spillway could cause compression between abutments during hot weather. Expansion joints need cleaning. Concrete deck on spillway bridge is OK. Trusses need cleaning and painting.

VISUAL INSPECTION CHECKLIST

DAM: Granville Reservoir MA 00707

DATE: June 6, 1980

AREA EVALUATED

CONDITION

OUTLET WORKS - SERVICE BRIDGE

a. Superstructure

Bearings	Not visible - bridge seat needs cleaning and painting. Heavy accumulation of dirt and weathered concrete.
Anchor Bolts	None visible
Bridge Seat	Needs cleaning and painting
Longitudinal Members	Trusses OK; need cleaning and painting
Under Side of Deck	Wood plank decayed
Secondary Bracing	Steel - should be cleaned and painted
Deck	1 plank decayed
Drainage System	None
Railings	Need strengthening
Expansion Joints	None
Paint	Steel - needs cleaning and painting

b. Abutment & Piers

General Condition of Concrete	Fair - pilaster cracked at control tower; pier cracked near dam
Alignment of Abutment	OK
Approach to Bridge	Backwall cracked
Condition of Seat & Backwall	Seat needs maintenance; backwall cracked - should be kept clean.

APPENDIX B

ENGINEERING DATA

- B-1. LIST OF AVAILABLE DESIGN, CONSTRUCTION
AND MAINTENANCE RECORDS
- B-2. PREVIOUS INSPECTION REPORTS
- B-3. PLANS, SECTIONS AND PROFILES
- B-4. BORING LOGS

LIST OF AVAILABLE DESIGN
CONSTRUCTION AND MAINTENANCE RECORDS

- A. PLANS AND SPECIFICATIONS - Original Contract Plans (1926) and Specifications, some design records including flow hydrographs, and construction correspondence and records are available from the office of the City Engineer, City of Westfield, City Hall, 59 Court Street, Westfield, MA. Additional sets of plans and records are available from the Westfield Water Department at the same address and at the damsite.
- B. MAINTENANCE - Recent maintenance records are on file at the Westfield Water Department office and the City Engineer's office.

PREVIOUS INSPECTION REPORTS

Inspections of dams were performed by the Massachusetts Department of Public Works, District 2, and are on file at District 2 Headquarters, North King Street, Northampton, Massachusetts.

Earlier inspections were performed by the Hampden County Engineer and are filed in the office of the County Highway Engineer, Hampden County Hall of Records, 50 State Street, Springfield, Massachusetts.

Copies of Selected Previous Inspection Reports follow.

APPENDIX B-2

INSPECTION REPORT - DAMS AND RESERVOIRS

(1)

LOCATION:

City/Town Granville County Hampden Dam No. 2-7-112-9

Name of Dam Granville Reservoir

Mass. Rect.

Topo Sheet No. 9 D Coordinates: N 399,500 E 234,200

Date

Inspected by: Harold T. Shumway On April 21, 1977 Last Inspection 9-9-76

(2)

OWNER/S: As of April 21, 1977

per: Assessors _____, Reg. of Deeds _____, Prev. Insp. X, Per. Contact X

City of Westfield

1. Board of Commissioners, Municipal Building, Westfield, Mass.

Name _____ St. & No. _____ City/Town _____ State _____ Tel. No. _____

2. _____
Name _____ St. & No. _____ City/Town _____ State _____ Tel. No. _____

3. _____
Name _____ St. & No. _____ City/Town _____ State _____ Tel. No. _____

(3)

CARETAKER: (if any) e.g. superintendent, plant manager, appointed by
absentee owner, appointed by multi owners.

Mr. Leonard E. Phelon, Supt. of Water Dept., Municipal Building, Westfield, Mass.

Name _____ St. & No. _____ City/Town _____ State _____ Tel. No. _____

(4)

DATA:

No. of Pictures Taken None Sketches See description of Dam.
Plans, Where At caretaker's office at dam.

(5)

DEGREE OF HAZARD: (if dam should fail completely)*

- | | |
|-------------------|--------------------------|
| 1. Minor _____ | 3. Severe <u>X</u> _____ |
| 2. Moderate _____ | 4. Disastrous _____ |

Comments: Approximately 547 million gallons impoundment, development is increasing down stream.

*This rating may change as land use changes (future development).

6. OUTLETS: OUTLET CONTROLS AND DRAWDOWN

42" diam. concrete blow off pipe from intake structure
No. 1 Location and Type: in pond through the upper gate house, then to blow off structure to an outlet 250' beyond toe of slope.

Controls Yes, TYPE: Twin 42" gate valves in dry well of gate house.

Automatic . Manual X. Operative Yes Unk., No .

Comments: Has not been operated for many years.

South end of dam-concrete slide chute spillway-60'W.X
No. 2 Location and Type: to 9'h. and 860' long, with 2'H. weir at dam and conc bucket at outlet end.

Controls Yes, Type: 1' high flashboards on crest of weir.

Automatic . Manual X. Operative Yes X, No .

Comments: Minor to moderate spalling of concrete floor of chute-several surface cracks.

No. 3 Location and Type: 24" C.I. pipe from upper gate house to lower gate house feeds into municipal water supply system.

Controls Yes, Type: 24" gate valves in both wet well and dry well of gate house.

Automatic . Manual X. Operative Yes X, No .

Comments: Valves operable per word of care taker.

Drawdown present Yes X, No . Operative Yes , No .

Comments: See No. 1 above.

7. DAM UPSTREAM FACE: 1:1 above water level
3:1 below water, Depth Water at Dam 50' to 55' level.

Material: Turf . Brush & Trees . Rock fill X. Masonry X. Wood .
Spillway

Other

Condition: 1. Good . 3. Major Repairs .

2. Minor Repairs X. 4. Urgent Repairs .

Comments: Surface cracks and moderate spalling on concrete structures-many misplaced stones on dry stone masonry wall on southerly bank of pond.

8. DAM DOWNSTREAM FACE: 2:1 from top to berm 45' below.
Slope 2:1 from berm to toe.

Material: Turf X. Brush & Trees . Rock Fill . Masonry . Wood

Other Rock fill toe at bottom of slope per construction plans.

Condition: 1. Good . 3. Major Repairs .

2. Minor Repairs X. 4. Urgent Repairs .

Comments: Several areas of cracks and spalling on spillway chute floor moderate spalling on concrete outlet structures.

9 EMERGENCY SPILLWAY: Available Yes. Needed _____.

Height Above Normal Water 0 Ft.

Width 60 Ft. Height 9 Ft. Material Concrete.

Condition: 1. Good _____.

3. Major Repairs _____.

2. Minor Repairs X.

4. Urgent Repairs _____.

Comments: Side chute spillway serves as emergency spillway-minor to moderate
spalling of chute floor-minor surface cracks-minor seepage flows noted
along sidewalls.

10 WATER LEVEL AT TIME OF INSPECTION: 1 Ft. Above X. Below _____.

Top Dam _____ F.L. Principal Spillway X.

Other _____.

Normal Freeboard 10 to 12 Ft. To top of dam.

11 SUMMARY OF DEFICIENCIES NOTED:

Growth (Trees and Brush) on Embankment None found.

Animal Burrows and Washouts 2 woodchuck holes on downstream slope.

Damage to Slopes or Top of Dam See burrows above.

Cracked or Damaged Masonry Surface cracks and spalling of concrete structures.

Evidence of Seepage What appears to be normal flow through seepage weir.

Evidence of Piping None found.

Leaks None found.

Erosion None found.

Trash and/or Debris Impeding Flow None found.

Clogged or Blocked Spillway None found.

Other _____.

(12)

OVERALL CONDITION:

1. Safe _____
2. Minor repairs needed X
3. Conditionally safe - major repairs needed _____
4. Unsafe _____
5. Reservoir impoundment no longer exists (explain)
Recommend removal from inspection list _____

(13)

REMARKS AND RECOMMENDATIONS: (Fully Explain)

Mr. Donald Lobban, temporary caretaker of dam, was present during this inspection. Considerable repair work has been accomplished since last inspection of Sept. 9, 1976, and this inspection was done in response to a written request by the owners to the D.E.Q.E. Division of Waterways office, dated 11-1-76 and received by the District office on March 1, 1977. The large boil of 6" to 8" diam., has been repaired. Investigation by the Water Dept. showed this to be a leak from a water main, which was dug up and repaired. The paved drainage gutters and catch basins on the down stream slope have been cleared of vegetation cuttings and appear to be in good working condition now. The small boil of 3" diam., noted in the floor of outlet structure on previous inspection is no longer visible. Due to a clogged sub drain in the floor of the outlet channel for draw down structure, a considerable amount of water, to a depth of 1½' to 2', has collected in the area where boil was last seen.

The seepage flow through the southerly measuring weir appears to have slowed down since last inspection and is now at about the normal volume noted over the past years. The reason for this slow down is unknown. It would seem advisable for a systematic schedule of measuring seepage flows and recording same to be set up by the owners.

HTS/at

March 2, 1977

SUBJECT: Dam - Granville
Granville Reservoir Dam
Dam No. 2-7-112-9.

Mr. Robert T. Tierney, P.E.
Chief Engineer
Mass. Dept. Public Works
100 Nashua Street
Boston, Massachusetts 02114

ATTENTION: Mr. John J. Hannon, P.E., Chief
Engineer of Waterways Division

Dear Sir:

In response to a letter received from Mr. John J. Hannon, Chief Engineer of the Waterways Division, Department of Environmental Quality Engineering, dated February 15, 1977, the District II office contacted Mr. L. E. Phelon by telephone. Mr. Phelon affirmed that the large boil noted in the service road on the inspection of the above listed dam on September 9, 1976 has been eliminated by repairing a leak in a 20 inch main in the area. Mr. Phelon also agreed that this was the only repair accomplished to date.

Due to other problems noted at the last inspection of this dam on September 9, 1976 the District recommends continuing the present rating of "conditionally safe-major repairs needed" on this dam at least until such time as a reinspection of the dam can be made. A considerable snow and ice cover makes such an inspection impractical at present time.

Very truly yours,

Francis J. Moey

FRANCIS J. MOEY, P.E.
District Highway Engineer

HJM/fo
JLM

B2-5



The Commonwealth of Massachusetts #1985

EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL QUALITY ENGR.
DIVISION OF WATERWAYS

100. Nashua Street, Boston 02114

February 15, 1977

Mr. Francis J. Hoey, P.E.
North King Street
Northampton, Ma.

Re: Dam #2-7-112-9
Granville, Ma.

Sir:

Enclosed is a copy of correspondence from Mr. Leonard E. Rhelan,
Water Superintendent for the City of Westfield regarding the Granville Reservoir
Dam in the Town of Granville. We solicit your view of Mr. Phelan's request.

Very truly yours,

John J. Hannon 6001



City of Westfield, Massachusetts

WATER DEPARTMENT

DEPARTMENT OF
ENVIRONMENTAL QUALITY ENGINEERING
DIVISION OF WATERWAYS
November 1, 1976

John J. Hannon, P.E.
Chief Engineer

RECEIVED NOV 3 1976

Referred To: J. H
Report back to: ASAP
File: _____

Dear Mr. Hannon:

We are writing concerning Reinspection Dam #2-7-112-9 Granville Reservoir, Granville dated September 27, 1976. Since your inspection of the dam site we have eliminated the larger boil on the service Road which was a leaking joint in the 20 inch main running under said road. We have also contacted Tighe & Bond Consulting Engineers and they are studying the other problems noted in your report. In view of the action taken by us, we request that you review your rating of this Dam as "Conditionally safe-major repairs needed", to a more favorable rating. We would appreciate your immediate attention to this request.

Very truly yours,

(s) Leonard E. Phelon

Leonard E. Phelon
Water Superintendent

B2-7

Handwritten note:
1/22/77
Hannon
11-1-76

INSPECTION REPORT - DAMS AND RESERVOIRS

1. LOCATION:

City/Town Granville County Hampden Dam No. 2-7-112-9

Name of Dam Granville Reservoir

Mass. Rect.

Topo Sheet No. 9 D Coordinates: N 399,500 E 234,200

Inspected by: Harold T. Shumway , On Sept. 9, 1976 Date 10-17-74 Last Inspection

2. OWNER/S: As of Sept. 9, 1976

per: Assessors _____, Reg. of Deeds _____, Prev. Insp. X, Per. Contact X

City of Westfield

1. Board of Water Commissioners, Municipal Building, Westfield, Mass.

Name _____ St. & No. _____ City/Town _____ State _____ Tel. No. _____

2. _____
Name _____ St. & No. _____ City/Town _____ State _____ Tel. No. _____

3. _____
Name _____ St. & No. _____ City/Town _____ State _____ Tel. No. _____

3. CARETAKER: (if any) e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.

Mr. Leonard E. Phelon, Supt. of Water Dept., Municipal Building, Westfield, Mass.

Name _____ St. & No. _____ City/Town _____ State _____ Tel. No. _____

4. DATA:

No. of Pictures Taken None Sketches See description of Dam.
Plans, Where At Caretaker's Office at Dam

5. DEGREE OF HAZARD: (if dam should fail completely)*

1. Minor _____ 3. Severe X

2. Moderate _____ 4. Disastrous _____

Comments: Approximately 547 million gallons impoundment, development is increasing downstream.

*This rating may change as land use changes (future development).

6. OUTLETS: OUTLET CONTROLS AND DRAWDOWN

No. 1 Location and Type: 42" concrete blowoff pipe from intake structure in pond through upper gatehouse, then to blowoff structure to an outlet 250' beyond toe of slope.

Controls Yes, TYPE: Twin 42" gate valves in dry well of gatehouse.

Automatic . Manual y. Operative Yes Unk., No .

Comments: Has not been operated for many years.

No. 2 Location and Type: South end of dam - concrete side chute spillway - 60'W.x to 9' H. and 860' Long, with 2'H. weir at dam and bucket at outlet end.

Controls Yes, Type: 1'H. flashboards on crest of weir.

Automatic . Manual X. Operative Yes X, No .

Comments: Spillway chute narrows to 10' width on bottom approx. 40' from intake. Minor spalling and surface cracks in abutment faces.

No. 3 Location and Type: 24" C.I. pipe from upper gatehouse to lower gatehouse feeds into municipal water supply system.

Controls Yes, Type: 24" gate valves in both wet well & dry well of gatehouse.

Automatic . Manual X. Operative Yes X, No .

Comments: Valves operable per word of Caretaker.

Drawdown present Yes X, No . Operative Yes Unk., No .

Comments: See No. 1 above.

7. DAM UPSTREAM FACE: 1:1 above water level
Slope 3:1 below water, Depth Water at Dam 50' to 55'.

Material: Turf . Brush & Trees . Rock fill X. Conc. Masonry X. Wood .
Spillway structure

Other .

Condition: 1. Good . 3. Major Repairs .

2. Minor Repairs X. 4. Urgent Repairs .

Comments: Minor spalling of concrete structures

8. DAM DOWNSTREAM FACE: 2:1 from top to berm 45' below
Slope 2 1/2:1 from berm to toe.

Material: Turf X. Brush & Trees . Rock Fill . Masonry . Wood .

Other Rock fill toe at bottom of slope - per const. plans.

Condition: 1. Good . 3. Major Repairs .

2. Minor Repairs . 4. Urgent Repairs X.

Comments: See Remarks concerning seepage flows and boils, Minor spalling and cracks in chute spillway - see Remarks

9. EMERGENCY SPILLWAY: Available Yes. Needed .

Height Above Normal Water: 0 Ft.

Width 60 Ft. Height 9 Ft. Material concrete.

Condition: 1. Good . 3. Major Repairs .

2. Minor Repairs x. 4. Urgent Repairs .

Comments: Side chute spillway serves as an overflow spillway and an emergency spillw.
minor spalling in some areas - minor seepage flows from adjacent natural
ground slopes, some surface cracks noted.

10. WATER LEVEL AT TIME OF INSPECTION: 2 1/2 Ft. Above . Below x.

Top Dam F.L. Principal Spillway .

Other Top of flashboards on crest of spillway.

Normal Freeboard 10 to 12 Ft. to top of dam.

11. SUMMARY OF DEFICIENCIES NOTED:

Growth (Trees and Brush) on Embankment None found.

Animal Burrows and Washouts 1 woodchuck hole at toe of dam.

Damage to Slopes or Top of Dam None found.

Minor spalling of upper gatehouse walls - spalling and
Cracked or Damaged Masonry cracks in spillway abuts. - minor spalling of chute floor
sidewalls - moderate spalling of conc. outlet structure for 42" blow.

Evidence of Seepage Yes - flows of several G.P.M. noted - see Remarks.

Evidence of Piping Yes - 2 ea. boils noted - see Remarks for description.

Leaks None found.

Erosion None found.

Trash and/or Debris Impeding Flow Minor vegetation cuttings in gutter drains.

Clogged or Blocked Spillway None.

Other Northerly C.B. at toe of slope with overflow for measuring seepage appears
blocked.

(12.)

OVERALL CONDITION:

1. Safe _____
2. Minor repairs needed _____
3. Conditionally safe - major repairs needed X _____
4. Unsafe _____
5. Reservoir impoundment no longer exists (explain)
Recommend removal from inspection list _____

(13.)

REMARKS AND RECOMMENDATIONS: (Fully Explain)

Mr. Benjamin Ciepiela, resident caretaker of this dam, was present during this inspection. The alignment and grade of the dam appeared good. The side chute spillway structure appeared to be in satisfactory condition with minor spalling of chute floor at construction joints and along seams where floor and sidewalls join noted. Very minor seepage was noted on the southerly sidewall of chute in construction joints near intake end of spillway. Minor spalling of gatehouse walls was noted. Some spalling and cracks were noted in the abutment walls of the spillway. There were various amounts of vegetation cuttings partially clogging the paved drainage gutters and catch basins on downstream slope. The northerly catch basin with an overflow for measuring seepage flows appeared to be clogged and should be cleaned out. Mr. Ciepiela stated that he would have this cleaned immediately. The southerly weir chamber was clear and approximately a 5/8 inch of flow was noted at time of inspection. The caretaker stated that normal flow has been 1/2 inch or approximately 11 thousand gallons per day. At the outlet end of this seepage drain, which is just below lower gatehouse structure, a minor amount of fines has formed a small delta in the drainage channel. These fines could be entering the seepage drain system below the weir chamber. Water flow appeared clear on day of inspection. An approximately equal water flow was noted emerging from the northerly seepage drain system, but no fines were noted in this area.

A small boil of 3"⁺ in diameter, was noted in the stone paved floor of the outlet structure for the 42" blowoff or drawdown pipe. This boil had a clear flow and no fines were evident around it. However, a water depth of 2" to 10" exists in this area due to seepage drain system runoff and due to a partially clogged drain pipe in floor of blowoff chute. This water accumulation made a close inspection assessment of this boil difficult. On the northerly side of this blowoff and drainage channel is a hard packed gravel service road running approximately parallel with the drainage channel.

- 5 -

REMARKS AND RECOMMENDATIONS: (Cont'd.)

Approximately 250' easterly or downstream from the lower gatehouse and in the northerly wheel track of the service road there is a large boil of 6" to 8" in diameter. This boil is of quite recent origin per word of Water Department personnel present at time of inspection. This boil appears to have considerable pressure and was moving aggregate particles up to $\frac{3}{8}$ of an inch in size in the cup of the boil. There was no evidence of fines buildup in the area due to traffic on service road and extreme wetness of area from boil. It appears that this boil is the result of a piping condition under or through the dam and the District recommends that owners be requested to make an immediate investigation of this situation and to take prompt corrective measures. It would also seem advisable for owners to investigate the cause of small boil in floor of blowoff chute structure and the increase, if any, in the seepage flows.

There is approximately 547 million gallons of water impounded by this dam and the Winchell Reservoir Dam, No. 2-7-112-10, is a short distance downstream. There is also increasing development in the Munn Brook area downstream in the Town of Southwick.

Because of the existence of the above described boils and increasing seepage flow, the District rates this dam as conditionally safe - major repairs needed.

HTS/vk
C - HEB

November 20, 1974

Board of Water Commissioners
Municipal Building
Westfield, Mass. 01085

Re: Inspection-Dam #2-7-112-9
Granville
Granville Reservoir Dam

Gentlemen:

On October 17, 1974, an engineer from the Massachusetts Department of Public Works made a visual inspection of the above dam, owned by the Board of Water Commissioners.

The inspection was made in accordance with Chapter 253 of the Massachusetts General Laws, as amended by Chapter 595 of the Acts of 1970 (Dams-Safety Act).

The results of the inspection indicate that this dam is well maintained and appears safe.

Measurements of the seepage flow of the underdrain system have been recorded since 1942. A quick check of these records show a drop in the amount of water flowing from the slope drainage system in recent years. It is suggested that an evaluation-inspection of these records and of the underdrain system be conducted. It is recommended that you obtain the services of a Registered Professional Civil Engineer experienced in the design, maintenance and construction of dams.

We call this to your attention now, before it becomes serious and more expensive to correct.

Very truly yours,

ALD

NORMAN L. DINDOLI P.E.
Acting Deputy Chief Engineer

2-4
LR:sh
c. c. F. J. Hoey
R. Falls

October 29, 1974

SUBJECT: Dams - Granville
Granville Reservoir Dam
Dam Number 2-7-112-9

Mr. Malcolm E. Graf
Associate Commissioner
Massachusetts Department of Public Works
100 Nashua Street
Boston, Massachusetts 02114

Attention: Mr. Norman L. Diegoli, P. E.
Acting Deputy Chief Engineer for Waterways

Dear Sir:

Enclosed are Dam Description and Dam Inspection Reports for the
Granville Reservoir Dam, Number 2-7-112-9, in Granville.

Very truly yours,

FRANCIS J. MCELY, P. E.
District Highway Engineer

RCS/sd
C - RTT
HFB

Enclosures

B2-14

INSPECTION REPORT - DAMS AND RESERVOIRS

(1.)

LOCATION:

City/Town Granville County Hampden Dam No. 2-7-112-9

Name of Dam Granville Reservoir

Mass. Rect.

Topo Sheet No. 9D Coordinates: N 399,500, E 234,200

Date

Inspected by: Russell C. Salls, P.E. On 10/17/74 Last Inspection 10/17/70

(2.)

OWNER/S: As of October 17, 1974

per: Assessors X, Reg. of Deeds , Prev. Insp. , Per. Contact X

1. Board of Water Commissioners, Municipal Building, Westfield, Mass. 01085
Name St. & No. City/Town State Tel. No.

2.
Name St. & No. City/Town State Tel. No.

3.
Name St. & No. City/Town State Tel. No.

(3.)

CARETAKER: (if any) e.g. superintendent, plant manager, appointed by
absentee owner, appointed by multi owners.

Mr. Leonard E. Phelon, Supt. of Water Department, Municipal Building, Westfield, Ma.
Name St. & No. City/Town State Tel. No.
Tel. No. 568-1612 or 562-9292

(4.)

DATA:

No. of Pictures Taken None Sketches See description of Dam.
Plans, Where At caretaker's Office at dam

(5.)

DEGREE OF HAZARD: (if dam should fail completely)*

1. Minor 3. Severe X

2. Moderate 4. Disastrous

Comments: Development is increasing downstream.

*This rating may change as land use changes (future development).

6.

OUTLETS: OUTLET CONTROLS AND DRAWDOWN

No. 1 Location and Type: 42" concrete blow-off pipe from intake structure in pond through upper gate house then to blow-off structure to an outlet 250' beyond toe slope.

Controls Yes, TYPE: Twin 42" gate valves in dry well of gate house

Automatic . Manual X. Operative Yes , No . Unknown.

Comments: Has not been operated for at least ten years.

No. 2 Location and Type: Concrete side chute spillway at right or south end of dam - 60' W. x 7' to 9' H. and 860'± L. with 2' high crest overflow weir at dam and bucket at outlet end.

Controls Yes, Type: 1' high flashboards on crest of roll over weir

Automatic . Manual X. Operative Yes X, No .

Comments: Spillway chute narrows to 10' width on bottom approx. 40'± from intake. Flashboards in place at time of inspection.

No. 3 Location and Type: 24" C.I. pipe from upper gate house to lower gate house feeds into Municipal Water Supply System.

Controls Yes, Type: Several 24" gate valves in both wet well and dry well of gate house - 24" blow-off to brook from lower gate house.

Automatic . Manual X. Operative Yes X, No .

Comments: Operated recently.

Drawdown present Yes X, No . Operative Yes , No . Unknown

Comments: See No. 1 Above.

7.

DAM UPSTREAM FACE: Slope 1:1 above water level 3:1 below water Depth Water at Dam 50' to 55'

Material: Turf . Brush & Trees . Rock fill X. Concrete Masonry X. Wood . Spillway Structure

Other

Condition: 1. Good X. 3. Major Repairs .

2. Minor Repairs . 4. Urgent Repairs .

Comments: Rock fill on slope extends to toe of slope. Portion above normal water is hand placed.

8.

DAM DOWNSTREAM FACE: Slope 2:1 from top to berm 45' below then 2½:1 to toe. Turfed surface

Material: Turf . Brush & Trees . Rock Fill . Masonry . Wood .

Other Rock fill toe at bottom of slope - per construction plans

Condition: 1. Good . 3. Major Repairs .

2. Minor Repairs X. 4. Urgent Repairs .

Comments: There is a system of slope drainage on slope with grouted stone gutters for surface water and under drains interconnected by catch basins, with most of flow passing through a weir chamber on south end downstream toe and a basin on north end so seepage quantities can be measured.

9. EMERGENCY SPILLWAY: Available See. Needed No.

Height Above Normal Water Zero Ft. Comment

Width Ft. Height Ft. Material

Condition: 1. Good . 3. Major Repairs .
2. Minor Repairs . 4. Urgent Repairs .

Comments: Side chute spillway serves as overflow spillway and emergency spillway.

Has an opening at upstream end of 60' x 7' under bridge over spillway.

10. WATER LEVEL AT TIME OF INSPECTION: 2 Ft. Above Below Y.

Top Dam F.L. Principal Spillway Y X

Other 2 feet below crest elevation spillway roll over.

Normal Pool Level 10' to 12' 50' to top of dam.

11. SUMMARY OF OBSERVED NOTES:

Growth (Weeds, etc.) on Foundation None observed.

Animal Burrows and Washouts None seen.

Damage to Slope on Top of Dam None seen.

Cracked or Damaged Masonry Only minor spalling of concrete surfaces.

Evidence of Seepage Considerable flow from seepage drainage system outlet. See
Remarks.

Evidence of Sliding None seen.

Leaks None seen.

Shrinkage None noted.

Temperature of Water None.

Clogged or Blocked Spillway No.

Other

(12.)

OVERALL CONDITION:

1. Safe _____.
2. Minor repairs needed X _____.
3. Conditionally safe - major repairs needed _____.
4. Unsafe _____.
5. Reservoir impoundment no longer exists (explain)
Recommend removal from inspection list _____.

(13.)

REMARKS AND RECOMMENDATIONS: (Fully Explain)

This water supply dam is reasonably well maintained and in general appears to be in satisfactory condition at this time. Mr. Benjamin Ciepiela, the Westfield Water Department representative at the dam was able to show us copies of the 1926 construction plans and to describe the most recent repair work done on the lower portion of the concrete side chute spillway.

This is an earth embankment dam with a stone fill upstream face and a stone toe fill at downstream slope toe. Stone walls along the tops of both slopes shown on the construction plans either were never built or removed at some later date. There is a Bituminous Concrete roadway across the top without guard rails of any sort. The stone fill at the downstream toe is covered with about two feet of loam and gravel and its existence could not be verified.

Some time since the completion of the dam a system of stone paved gutter together with an underdrainage system has been installed on the downstream slope. This system feeds into a weir chamber at the southerly end of the downstream slope and into a catch basin where flow quantities can be measured.

Mr. Ciepiela showed us records of measurement taken of the seepage flows at the above described weir and catch basin going back to 1942. He is continuing to take measurements and maintain these records up to date. A quick check of these records show a drop in the amount of water flowing from the slope drainage system in recent years.

According to Mr. Ciepiela and Mr. Phelon, Water Department Superintendent, there has been no evaluation of the seepage flow records. Both were unaware of any in the last ten years. These records were apparently initiated just after the slope drainage system was installed to monitor the seepage which appears to have been a problem before the construction of the drainage system. It would be reasonable to require an evaluation of these records and of the seepage condition from time to time by someone with a knowledge

RCS/js/sd

- 5 -

13. REMARKS AND RECOMMENDATIONS: (Continued)

of the effects of seepage flows on an earth embankment dam.

The side slope chute spillway is constructed of concrete. Some spalling of the sidewalls and floor slabs has recently been repaired with gunite and near the lower end a large section was replaced after being washed out by a heavy overflow. At present it is in satisfactory shape but its condition should be carefully evaluated during future inspections. The slope is quite steep and overflowing water can reach very high velocities. The bucket on the lower end has a lip about ten feet above the stream bed below and is founded on ledge. At the time of the inspection, one foot high flashboards were in place on the crest of the roll over at the inlet and water was about two feet below the crest.

Both gate houses were viewed and all the mechanism exposed was well lubricated and in good condition. Some spalling of the concrete wall structure of the upper gate house at the water line was observed but as yet this does not affect the stability of the structure.

Generally, the entire installation appears to be reasonably stable. No sags or settlement areas were observed and both slopes appeared true and free from slumps or slides. Vegetation over the downstream slope was uniform with no areas where excessive growth would indicate unusual dampness.

RCS/sd

DESCRIPTION OF DAM

DISTRICT II.

Submitted by Russell C. Sells, P. E. Dam No. 2-7-112-9

Date October 17, 1974 City/Town Granville

Name of Dam Granville Reservoir

1. Location: Topo Sheet No. 9D Mass. Rect. Coordinates N 399,500 E 234,200

Provide 8 1/2" x 11" in clear copy of topo map with location of Dam clearly indicated.

On Hollister Brook - Reached via private roadway from Winchell Road, northerly about 7/10 mile from southerly intersection with Old Westfield Road.

2. Year built 1928 Year/s of subsequent repairs 1970? Repairs to concrete spillway chute

3. Purpose of Dam: Water Supply X Recreational _____
Flood Control _____ Irrigation _____ Other _____

4. Drainage Area: 10+ sq. mi. 3200 acres.
Type: City, Bus. & Ind. _____ Dense Res. _____ Suburban _____ Rural, Farm 10%
Wood & Scrub Land 90% Slope: Steep 80% Med. 20% Slight _____

5. Normal Ponding Area: 73± Acres; Ave. Depth 22.5' to 23'
Impoundment: 540 Million gals.; 1660 acre ft.
Silted in: Yes X No _____ Approx. Amount Storage Area 10% ±

6. No. and type of dwellings located adjacent to pond or reservoir _____
i.e. summer homes etc. Caretaker's Office Building.

7. Dimensions of Dam: Length * 865' Max. Height 92' embankment 118' to lower and spillway chute.
Freeboard 10' to 12'
Slopes: Upstream Face 1:1 above water level; 3:1 below water 1:1
Downstream Face 2:1 to berm 45' below top then 2:1 to 1
Width across top 24'

* Includes side chute spillway 60' wide.

B2-20

Dam No. 2-7-112-9

8.

Classification of Dam by Material:

Earth X Conc. Masonry X Stone Masonry _____
in spillway
Timber _____ Rockfill _____ Other Upstream slope stone paved.

8A.

Dam Type: Gravity X Straight X Curved, Arched _____ Other _____
Overflow _____ Non-overflow X

9.

A. Description of present land usage downstream of dam:

85 % rural; 15 % ~~urban~~ Developed

B. Is there a storage area or flood plain downstream of dam which could accommodate the impoundment in the event of a complete dam failure? Yes X No _____ Not before Munn Brook enters Southwick

C. Character Downstream Valley: Narrow X Wide _____ Developed _____
Rural 85% Urban 10%

10.

Risk to life and property in event of complete failure.

No. of people Say 3 - 4 in Westfield

No. of homes 10 in Southwick and Westfield

No. of businesses 0

No. of industries 0

No. of utilities 4

Railroads 0

Other dams Winchell Reservoir Dam #2-7-112-10 just below. No others before the Little River.

Other Town Highway Bridges in Southwick and Westfield.

Possible damage to Stevens Paper Factories on Little River in Westfield
Transmission lines of Telephone and Electric Companies. - Westfield Water Supply Main and Springfield Aqueduct.

11.

Attach Sketch of dam to this form showing section and plan on 8½" x 11" sheet.

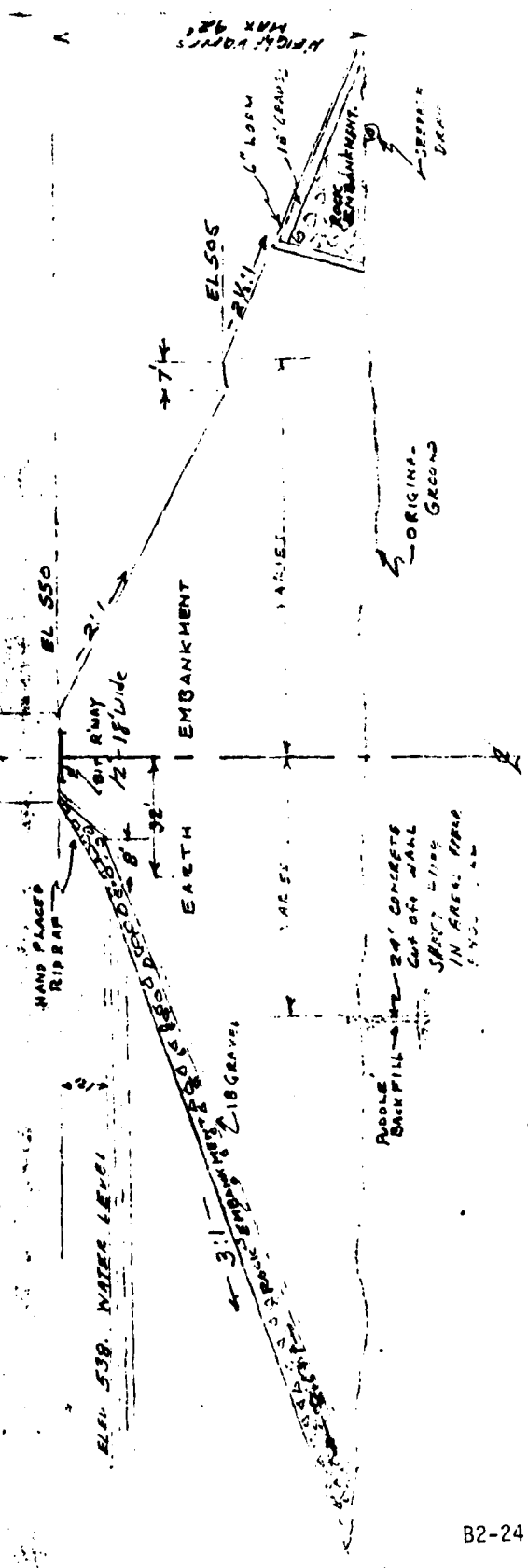
RCS/vk /ed
Attachments
Locus Plan
Sketches

DAM No. 2-7-1

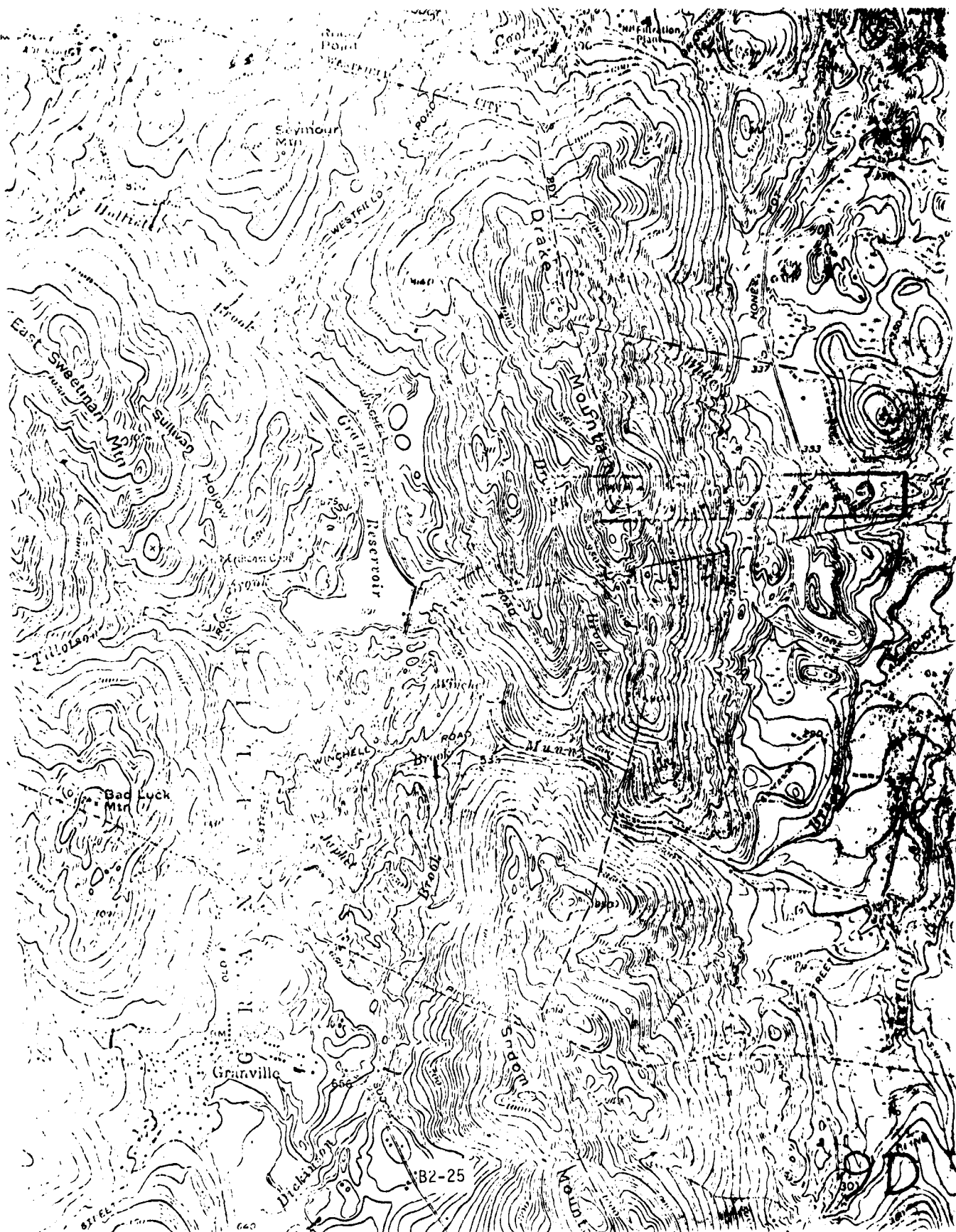


GRANVILLE RESERVOIR

SHEET 3 of 3 SHEETS
 SKETCH NOT TO SCALE



PC 31
 10 7 14



DAMS IN HAMPDEN COUNTY, MASSACHUSETTS (7)

GRANVILLE

✓ 1. DeGano Dam *7-10-9c*

Town of Granville, since Blandford Road, a public street, forms the dam.

✓ 2. Phelon Dam *7-10-10*

Mr. Russell Phelon, Granville, Mass.

✓ 3. Woodger Dam *7-10-3 (Sheet 90)*

Mr. G. E. Woodger, Granville, Mass.

✓ 4. Noble Cooley Drum Shop Dam *7-10-4 (Sheet 90)*

Noble Cooley Drum Shop, Granville, Mass.

✓ 5. Dickinson Dam *7-10-5 (Sheet 90)*

Mr. Glenn Dickinson, Sodom Road, Granville, Mass.

✓ 6. Don Noble Dam *7-10-6 (Sheet 90)*

Mr. Donald E. Noble, Maple St., Granville, Mass.

✓ 7. Cooley Estate Dam *2-7-12 7-10-7 (Sheet 90)*

Mr. Herbert A. Hires, Pine Lake, Granville, Mass.

✓ 8. Strong Dam *7-10-8 (Sheet 90)*

Westfield Water Dept., Municipal Building, Westfield, Mass.

✓ 9. Granville Reservoir Dam *7-10-9 (Sheet 90)*

Westfield Water Dept., Municipal Building, Westfield, Mass.

✓ 10. Winchell Dam *7-10-10 (Sheet 90)*

Westfield Water Dept., Municipal Building, Westfield, Mass.

**TIGHE
& BOND CONSULTING ENGINEERS**

Page 2 of 2

- ✓ 11. Japhet Dam G-10-11 (SHEET 90)
Westfield Water Dept., Municipal Building, Westfield, Mass.
- ✓ 12. Granville State Forest Dam G-10-12 (SHEET 9C)
Granville State Forest, Granville, Mass.
- ✓ 13. E. A. Jensen Dam G-10-13 (SHEET 9C)

Mr. Edward A. Jensen, Jensen Orchards, Granville, Mass.

SEE FOLLOWING, FOL G-10-14 & G-10-15
The last routine inspections of all dams within the Town of Granville were conducted in July and August of 1970. A letter-report on the conditions noted at each of the dams in the Town of Granville was submitted to the Commissioners of Hampden County on August 12, 1970.

Three of the thirteen dams in Granville were found to require certain maintenance and repair work. These are the Noble Dam, the Winchell Dam and the Granville State Forest Dam.

A copy of my report addressed to the Honorable, the Board of County Commissioners and dated August 12, 1970, is attached hereto for your information so that you will have first-hand knowledge of the recommendations for maintenance and repair work. Letters outlining the recommended maintenance and repair work were sent to each of the three dam owners by the County Commissioners.

The report to the County Commissioners also lists the Arnold Dam and the Wells Mills Dam. Both of these are upstream of the Strong Dam and are owned by the Westfield Water Dept. They are small in size and could be dropped from the routine inspection program.

George H. McDonnell
George H. McDonnell
County Hydraulic Engineer
Hampden County

The earth embankment was o. k.

The quantity of water stored by the dam is quite small and, even if the dam did fail, it could do no damage to persons and property downstream.

In the opinion of the undersigned, the dam is in satisfactory condition and is safe.

(d) 5-10-91 (SHEET 90)
Granville Reservoir Dam This dam is in the best condition observed in a number of years.

The spillway and the spillway chute are o. k. The repair work at the spillway chute and under the chute floor has been completed. The floor and the walls of the chute are satisfactory. Some of the thin gunite on the walls is cracking and lifting but this is a common occurrence with the type of plaster coat applied on certain sections of the spillway chute sidewalls.

The spillway energy dissipating wall at the end of the chute was noted to be o. k.

The spillway crest was in good condition. Water level was about two feet below the elevation of the crest. No flashboards were on the crest.

The embankment was in very good condition. The roadway along the top is in fair condition. The bridge carrying the roadway over the spillway and the foot bridge out to the gate house were o. k.

The water side slope of the embankment and its stone filled surface were noted to be in good condition.

The downstream slope of the embankment was in the best shape observed in some time. All brush has been cut and all of the surface drainage system has been dug out, cleared, and exposed. The undersigned was advised by the Water Dept. employee in charge of the dam that the stone masonry lining of the surface drainage system on the downstream face of the embankment will be repaired this year where necessary. Loose stones will be reset and open joints will be concreted.

The toe area was in very good condition. All brush growth has been cleared away. The toe drains were operating. One burrow hole was observed at the toe of the dam near the one large tree. This was pointed out and the supervisor of the dam will fill the burrow hole.

A. SKETCHES COMPILED DURING PHASE I INSPECTION SHOWING
GENERAL LAYOUT OF DAM, TYPICAL SECTIONS AND DETAILS
OF SIGNIFICANT FEATURES:

Figure 1. General Plan of Damsite

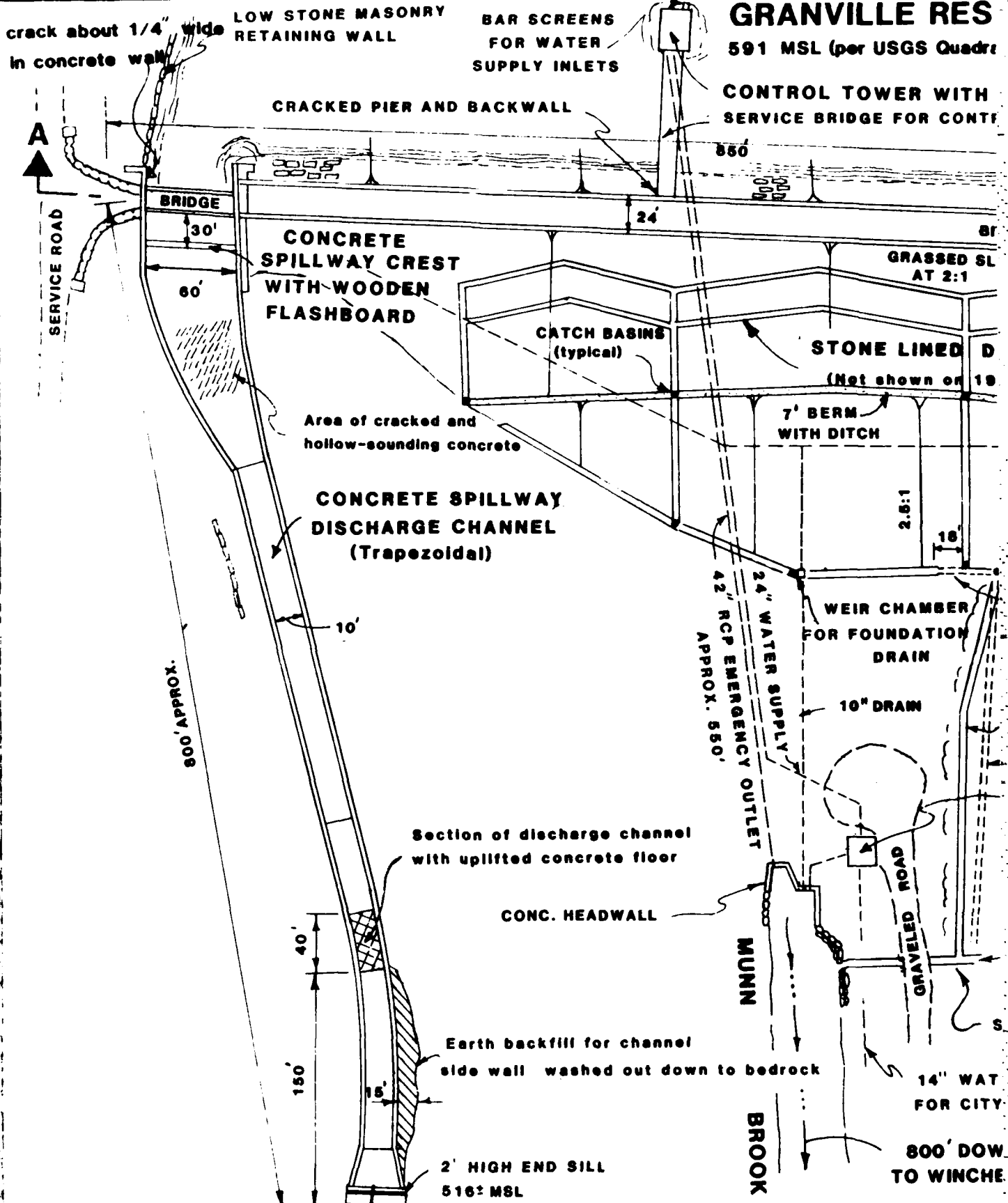
Figure 2. Typical Sections

B. RECORD PLANS:

Photographs of selected portions of original
Contract Drawings, Figures B-1 to B-4.

GRANVILLE RES

591 MSL (per USGS Quad)



SERVOIR

(Quadrangle)

H BRICK SERVICE BUILDING

CONTROL TOWER

RIPRAP ON 3:1 SLOPE

BIT. CONC. PAVEMENT SERVICE ROAD

SLOPE

DITCHES

(1926 plans)

OUTLET DRAIN FOR
SPRING AT NORTH
ABUTMENT 4-5 GPM

FOUNDATION DRAIN
AS SHOWN ON 1926 PLAN

10" STEEL CULV.

STONE WALLED OPEN DITCH

V.C. DRAIN PIPE

LOWER GATEHOUSE

DISCHARGE AREA FOR SPRING
AT NORTH ABUTMENT

STONE WALLED DITCH

WATER SUPPLY MAIN
OF WESTFIELD

DOWNSTREAM
OF GRANVILLE RESERVOIR

NOTE: Elevation datum is taken from U.S.G.S. Quadrangle. Normal pool elevation is assumed to be the top of 1 foot high flashboard on spillway crest elevation 591 MSL.



APPENDIX B-3 FIGURE 1

GENERAL PLAN

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS

ROBERT G. BROWN & ASSOCIATES, INC
Pittsfield, Massachusetts

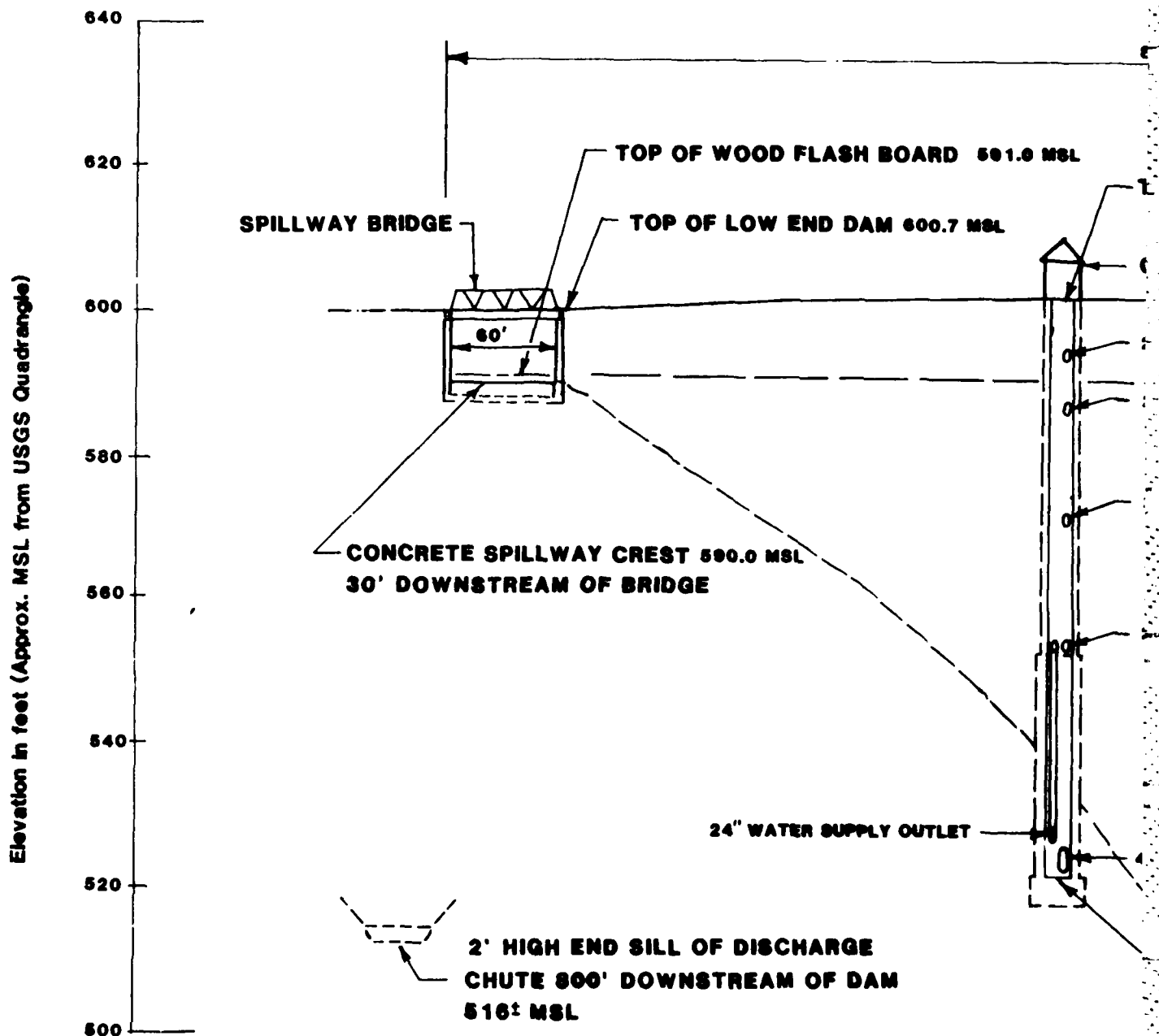
NATIONAL PROGRAM FOR
INSPECTION OF NON-FEDERAL DAMS
GRANVILLE RESERVOIR DAM
MA 00707
MUNN BROOK

GRANVILLE

MASSACHUSETTS

SCALE: NOT TO SCALE

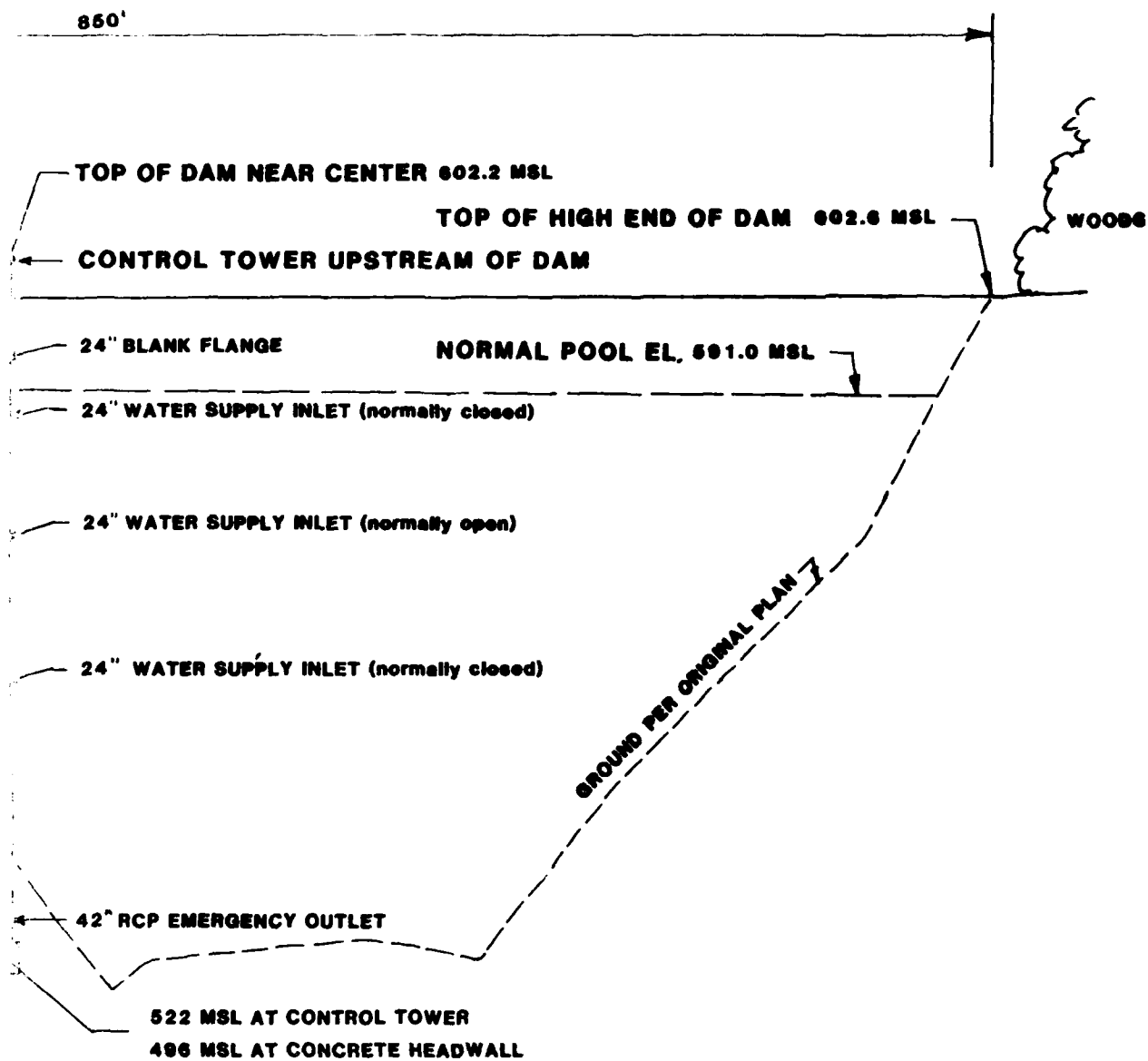
DATE: AUGUST 1980



SECTION A-A

NOT TO SCALE

NOTE: Elevation datum is taken from U.S.G.S. Quadrangle.
Normal pool elevation is assumed to be the top of
1' high flashboard on spillway crest elevation 591 MSL



A-A'

APPENDIX B-3 FIGURE 2

GRANVILLE RESERVOIR DAM

SHUMWAY
File No.

CITY OF WESTFIELD, MASS.
GRANVILLE STORAGE

John H. Barry
Chairman
John D. McKeon
Edw. J. Higgins

Board
of
Public
Works

Paul J. Parker Supt.

July 19, 1927

BOARD OF PUBLIC WORKS
WESTFIELD, MASS.
WATER SUPPLY GRANVILLE STORAGE

GENERAL PLAN

PLAN AND APPURTENANCES

CONTRACT

December 1927

PAID TO ORDER OF ENGINEERS

DECEMBER 1927

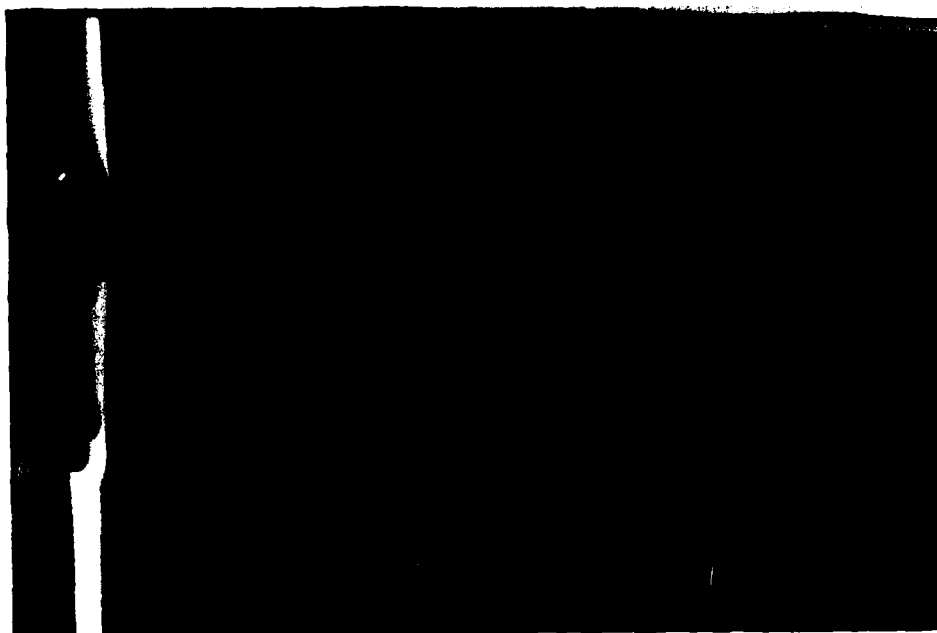
RECEIVED

OFFICE OF THE ENGINEER



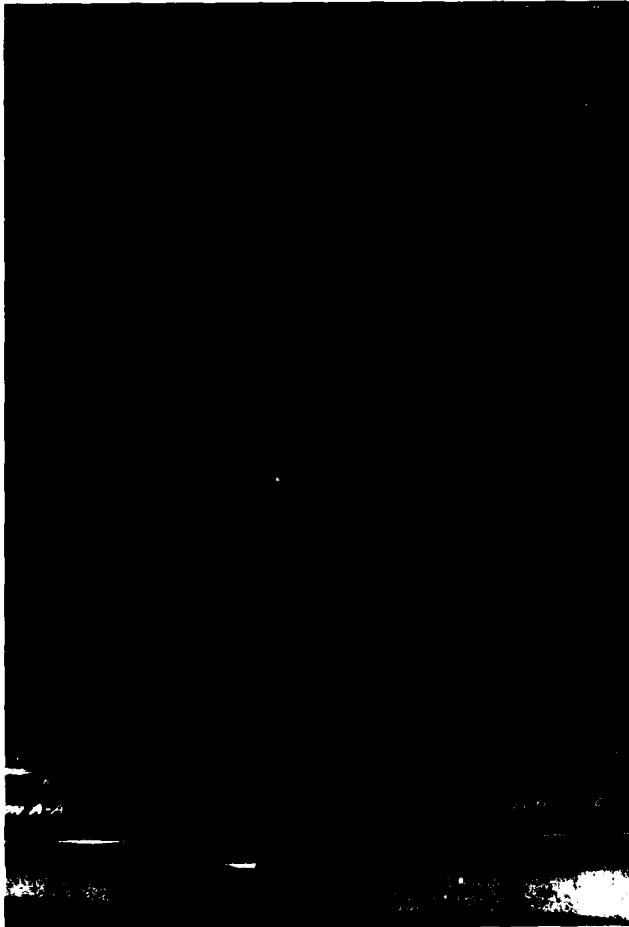
B-1

Photograph of 1926 plan
showing layout of dam
and spillway



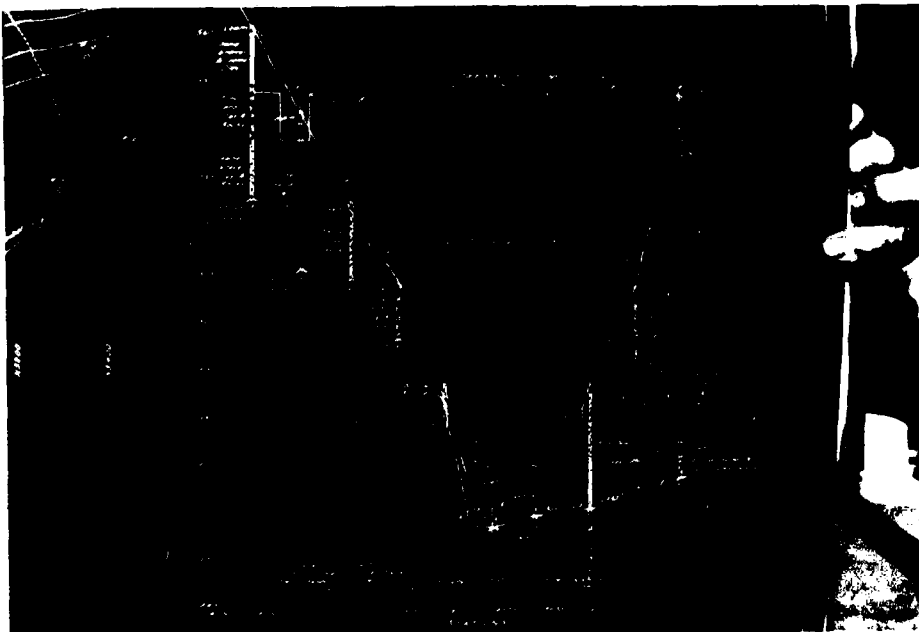
B-2 - Photograph of 1926 plan showing embankment sections. Note rock toe
with drain.

B3-4



B-3

Photograph of 1926 plan
showing valving in control
tower.



B-4 - Photograph of 1926 plan showing soils data. Note that plan datum varies from the USGS datum by about 52 feet as determined by comparison of water surface elevations on the 1926 Quadrangle (which has an expected accuracy of 1 foot).

B3-5

TYPICAL BORING LOGS

See Appendix B-3, Photograph B-4, for soils data. Soil samples are available at caretaker's office at the damsite.

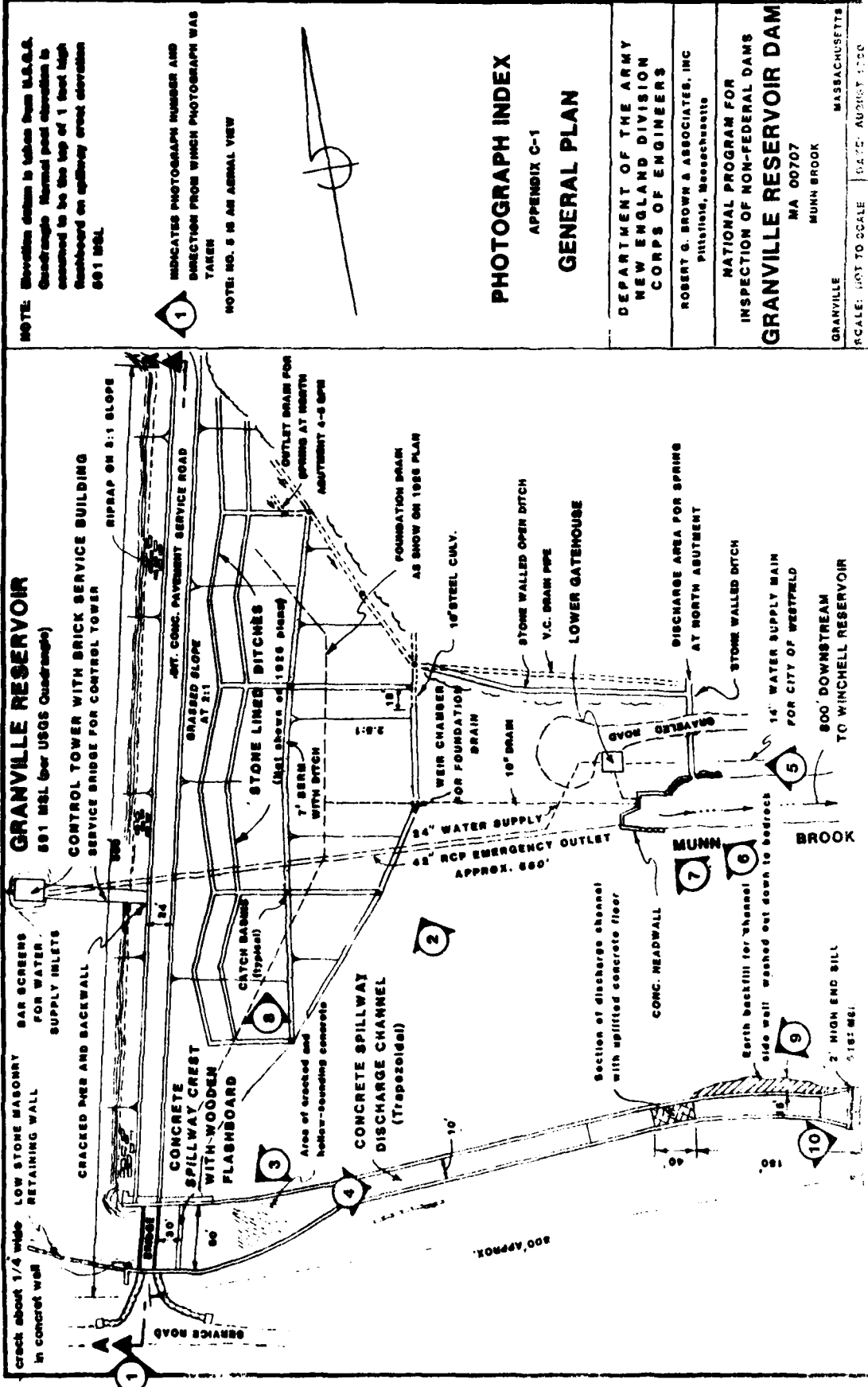
APPENDIX B-4

APPENDIX C

PHOTOGRAPHS

C-1. PHOTOGRAPH INDEX

C-2. SELECTED PHOTOGRAPHS



GRANVILLE RESERVOIR
591 MSL (for USGS Quadrangle)

CONTROL TOWER WITH BRICK SERVICE BUILDING
SERVICE BRIDGE FOR CONTROL TOWER

CRACKED DAM AND BACKWALL
BAR SCREENS FOR WATER SUPPLY INLETS

CONCRETE SPILLWAY CREST WITH WOODEN FLASHBOARD
CATCH BASIN (typical)

CONCRETE SPILLWAY DISCHARGE CHANNEL (Trapezoidal)
Area of cracked and hollow-sounding concrete

STONE LINER DITCHES
18\"/>

FOUNDATION DRAIN
AS SHOWN ON 1928 PLAN

WEIR CHAMBER FOR FOUNDATION DRAIN
16\"/>

STONE WALLED OPEN DITCH
V.C. DRAIN PIPE

LOWER GATEHOUSE
DISCHARGE AREA FOR SPRING AT NORTH ABUTMENT

STONE WALLED DITCH
14\"/>

DISCHARGE AREA FOR SPRING
AT NORTH ABUTMENT

STONE WALLED DITCH
14\"/>

14\"/>

800' DOWNSTREAM TO WINCHELL RESERVOIR

GRANVILLE RESERVOIR
591 MSL (for USGS Quadrangle)

CONTROL TOWER WITH BRICK SERVICE BUILDING
SERVICE BRIDGE FOR CONTROL TOWER

CRACKED DAM AND BACKWALL
BAR SCREENS FOR WATER SUPPLY INLETS

CONCRETE SPILLWAY CREST WITH WOODEN FLASHBOARD
CATCH BASIN (typical)

CONCRETE SPILLWAY DISCHARGE CHANNEL (Trapezoidal)
Area of cracked and hollow-sounding concrete

STONE LINER DITCHES
18\"/>

FOUNDATION DRAIN
AS SHOWN ON 1928 PLAN

WEIR CHAMBER FOR FOUNDATION DRAIN
16\"/>

STONE WALLED OPEN DITCH
V.C. DRAIN PIPE

LOWER GATEHOUSE
DISCHARGE AREA FOR SPRING AT NORTH ABUTMENT

STONE WALLED DITCH
14\"/>

DISCHARGE AREA FOR SPRING
AT NORTH ABUTMENT

STONE WALLED DITCH
14\"/>

14\"/>

800' DOWNSTREAM TO WINCHELL RESERVOIR



Figure 1 - View of dam looking north. Note riprap on upstream face of dam. Projection from upstream wall of the control tower contains the bar screens for the water supply inlets. Road over top of dam continues beyond the north abutment.



Figure 2 - View of the downstream face of dam showing stone lined drainage ditches.

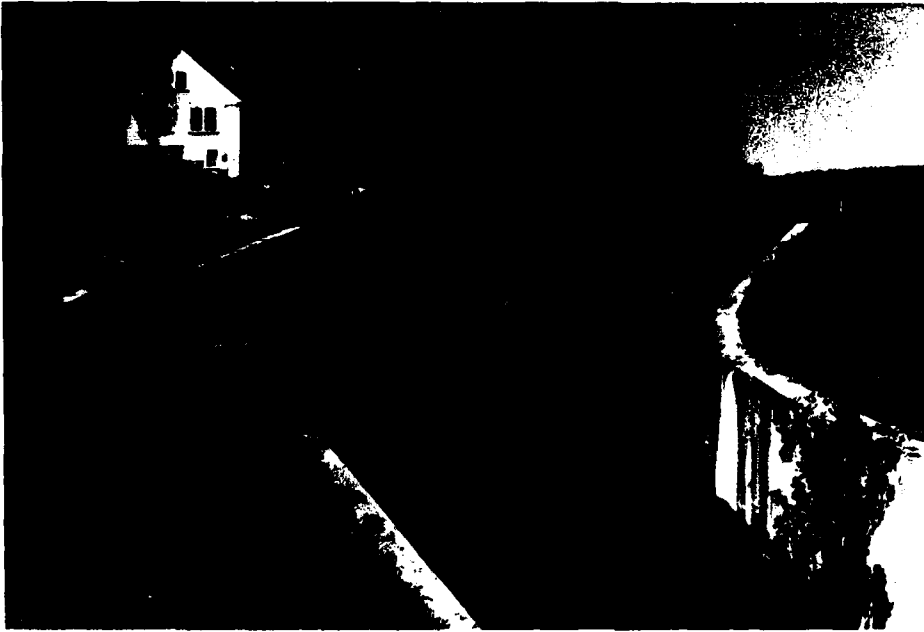


Figure 3 - View of the spillway crest and spillway bridge at south abutment. Note 1 foot high flashboard. Also note caretaker's office in house.

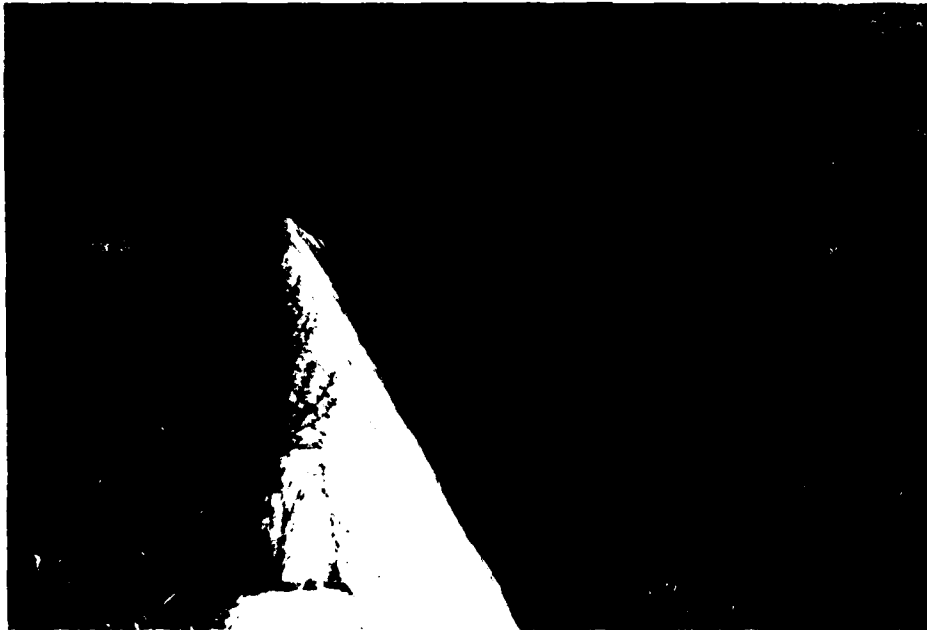


Figure 4 - Spillway discharge channel (10 feet wide with 3/4(H) to 1(V) sideslopes) looking downstream. Note low retaining wall on slope.



Figure 5 - Overview of downstream face of dam showing stone lined drainage ditches. Note taper (transition) in spillway discharge channel.



Figure 6 - View of the lower gate house containing the blow-off works for the water supply outlet. Note concrete headwall in foreground.



Figure 7 - View of the concrete headwall showing the outlet of the 42 inch conduit. The middle pipe at the headwall is the discharge for the foundation drain. The outlet to the right is the blow-off for the water supply outlet.



Figure 8 - Typical animal borrow (more than a dozen) noted on the downstream face of dam.



Figure 9 - View of the spillway discharge channel looking upstream at a section where the concrete floor has uplifted and flow has jumped the channel. This is at a location about 650 feet downstream of the dam.



Figure 10 - View of the natural channel downstream of the end of the spillway discharge channel. Note 2 foot high end sill at the end of discharge channel.



Figure 11 - Dam at Winchell Reservoir about 1500 feet downstream of Granville Reservoir Dam.

AD-A155 669

NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
GRANVILLE RESERVOIR D. (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV AUG 80

2/2

UNCLASSIFIED

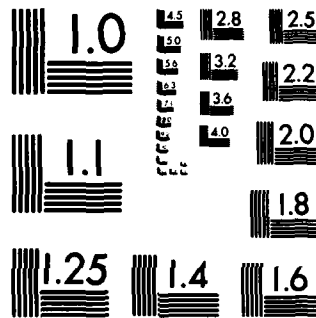
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FORM 1

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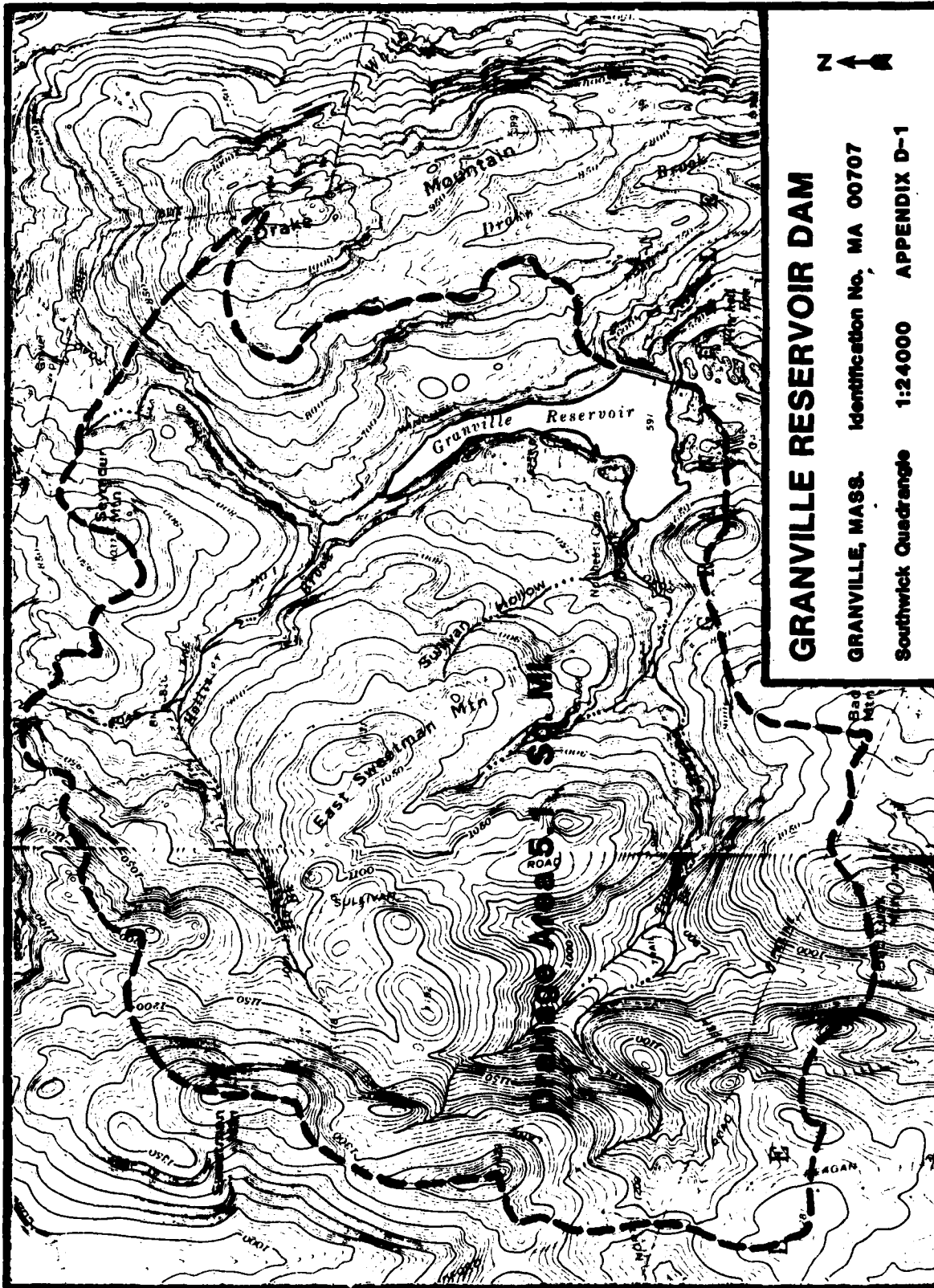
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

APPENDIX D

HYDRAULIC AND HYDROLOGIC COMPUTATIONS

D-1. DRAINAGE AREA MAP

D-2. COMPUTATIONS



GRANVILLE RESERVOIR DAM

GRANVILLE, MASS. Identification No. MA 00707

Southwick Quadrangle 1:24000 **APPENDIX D-1**



Robert G. Brown & Associates, Inc.
Berkshire Common Third Floor North
PITTSFIELD, MASSACHUSETTS 01201
(413) 499-1560

JOB MA 707 Granville Res.
SHEET NO. 1 OF 18
CALCULATED BY JFC DATE 5/29/80
CHECKED BY JMC DATE 7/29/80
SCALE _____

16.38 ✓ 1st reading of planimeter
32.75 ✓ 2nd " " " "

Drainage Area

by: USGS Quad 1:25000 Scale

$$32.75 D'' \times \frac{99.64 \text{ Ac.}}{D''} \times \frac{S.M.}{640 \text{ Ac.}} = 5.10 \text{ S.M.} \checkmark$$

Step 1 Calculate PMF using "Preliminary Guidance for Estimating Maximum Probable Discharges in Phase I Dam Safety Investigations" Mar. 1978

For Rolling Terrain 5.1 S.M.

$$\text{PMF} = 1850 \frac{\text{cfs}}{\text{S.M.}} \times 5.1 \text{ S.M.} = 9435 \text{ cfs} \checkmark$$

use 9450 cfs ✓

Hazard Class → High
Size → Large
Test Flood by
COE Guidelines → PMF

APPENDIX D-2

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JOB MA 707 Granville Res.
SHEET NO. 2 OF 18
CALCULATED BY JFC DATE 5/29/80
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SCALE _____

Step 2a Determine surcharge height to pass Q_p of 9450 cfs. Compute discharge rating curve and stage storage curve. Outflow would occur first over principal spillway. Higher flows would pass over embankment. The 42" outlet pipe will be considered open.

FOR spillway disch. use weir coeff.
 $C_d = 3.2$ for all heads, $Q = C_d L H_w^{3/2}$

For pipe flow use $Q = C_p H_p^{1/2}$

$$C_p = A_p \sqrt{\frac{2g}{1 + K_r + K_p L}}$$

$$K_r = 1.0$$

$$n = 0.015$$

$$L \approx 800' \checkmark$$

$$C_p = \frac{\pi (3.5)^2}{4} \left[\frac{2 \times 32.2}{1 + 1 + 0.00784 \times 800} \right] = 26.84 \checkmark$$

Assume existing 1' high flashboards yield.

Use USGS datum - el. 591 perm pool - 1' flashboards:
el. 590 MSL spillway crest.
This is approximately el. 538 on
datum of original plan.

Elevation of 42" outlet near lower gate house
is about -495 MSL

$$HT \text{ of dam} \approx 106' \checkmark$$

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JOB MA 707 Granville Res.
SHEET NO. 3 OF 18
CALCULATED BY JFC DATE 5/29/80
CHECKED BY JMC DATE 7/21/80
JFC 8/19/80
SCALE _____

Elev.	Flow over Spillway				Flow over Dam				Flow From 42" Φ			Q Total w/42" Φ	Q Total w/42" Gate	Q Total w/42" Gate
	C	L	H	Q	C _w	L	H _w	Q	C _p	H _p	Q _p			
MSL	3.2	60	0	0					26.8	93	259	259	259	0
590*	"	"	5	2146					"	98	265	2411	2411	2146
595	"	"	10	6071					"	"	"	6336	6336	6071
600 ^{TOP}	"	"	10.7	6720					"	"	"	6985	6985	6720
600.7 ^{TOP}	"	"	11	7004					"	104	273	7277	7277	7004
601 ^{TOP}	"	"	12.2	8182	2.6	200	0.5	184	"	"	"	8639	8639	8366
602.2 ^{TOP}	"	"	13	9000	2.6	"	2.5	1746	"	"	"	11019	11019	10746
603	"	"												

C_w could be a little higher with higher heads - assume constant - Bridge stringers will cause some headloss for weir downstream

* Equals el. 538.0 approx. on Plan datum

RG BROWN & ASSOC. INC.
JES 5/29/80
JMC 7/21/80

Note: Datum from USGS
Quadrangle
Top of Flashed Normal Pool 591 MSL

Top of Dam
602.2 MSL @ Center of Dam

Cap 141 1/2" Gate
Closed

Cap 141 1/2" Gate Open

ELEVATION MSL

DISCHARGE IN 1000 CFS

MA 107
GRANDVILLE RES.
RATING CURVE

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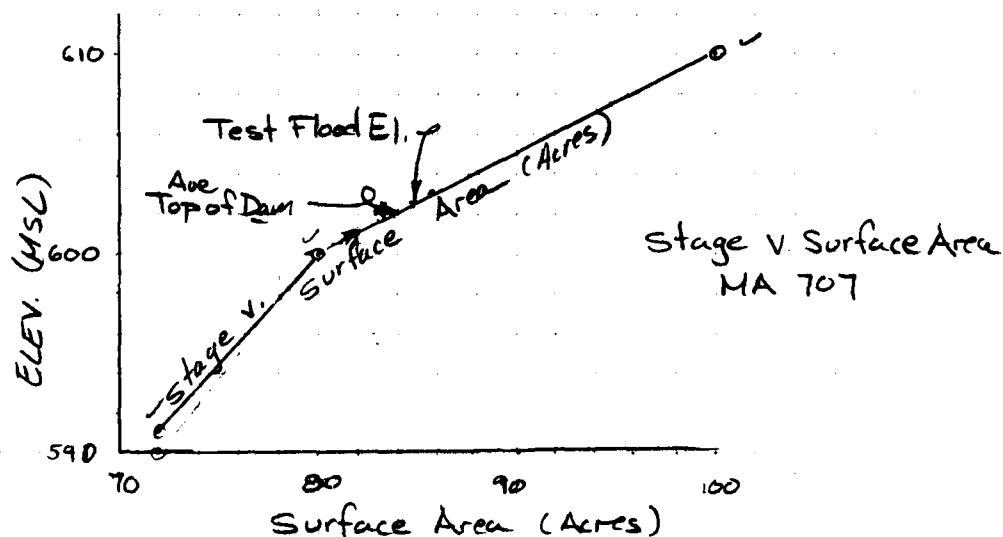
JOB MA707 Granville Res.
 SHEET NO. 5 OF 18
 CALCULATED BY JFC DATE 5/29/80
 CHECKED BY Jmc DATE 7/20/80
 SCALE _____

Calculate Stage v. Storage curve

For normal storage (level at top of 1' high flash boards)
 use 540 million gallons (Design data)

$$540 \text{ m.g.} \times \frac{2.07 \text{ Ac.-ft.}}{\text{m.g.}} = 1658 \text{ Ac.-ft.} \checkmark$$

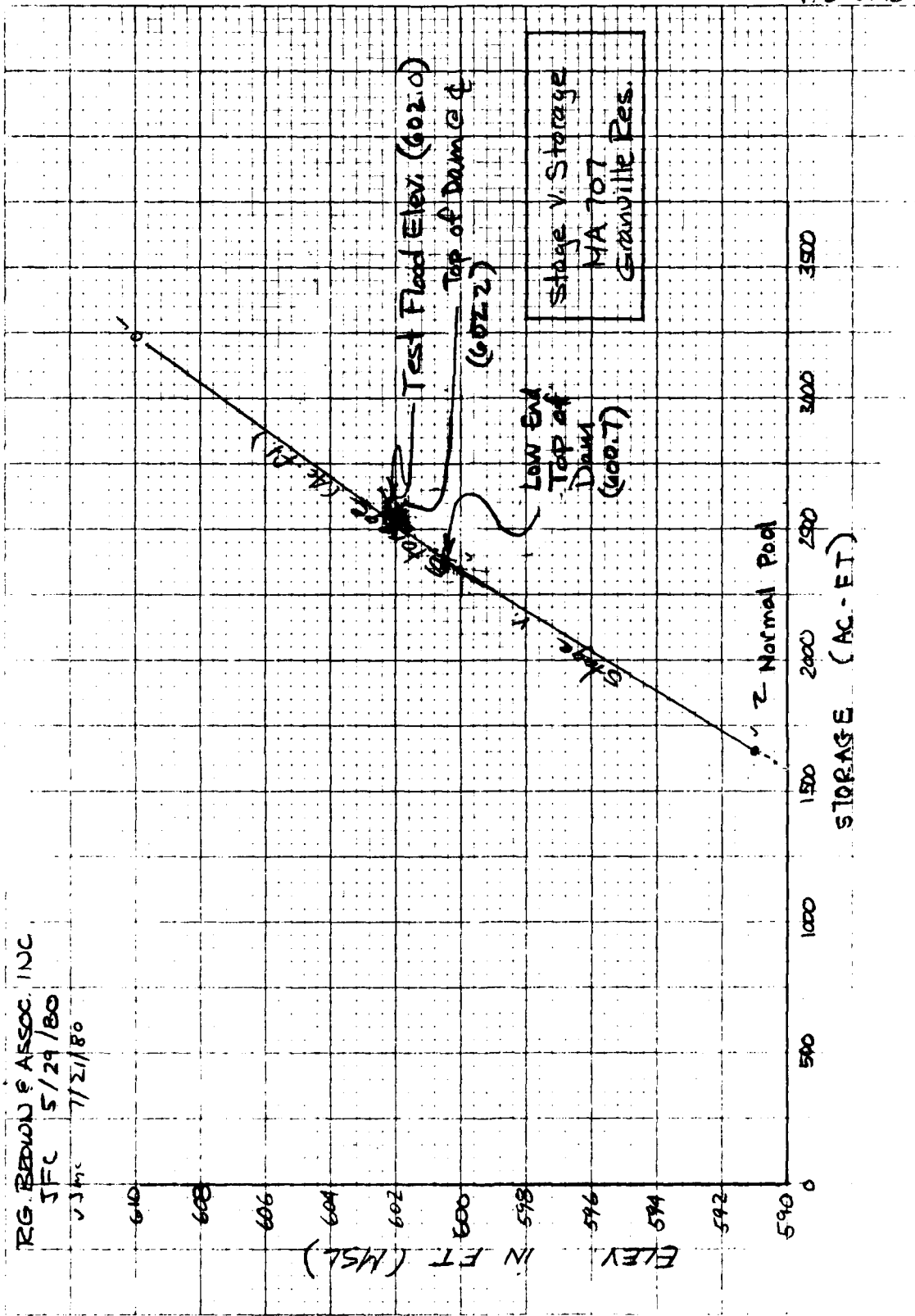
Elev. (MSL)	Area (Acres)	Σ Storage (Ac.-ft)
591	72 ✓	1658 ✓
600	80 ✓	2342 ✓
610	100 ✓	3242 ✓



RG. BEDOU & ASSOC. INC.

JFC 5/29/80

UJMC 7/2/80



Test Flood 100% PMF

Note: High Hazard, Large Size

Test Flood — 9450 cfs ✓ (PMF) — inflow

Elev. @ 9450 cfs — 602.9 ✓

Step 2b

Determine Volume of Surcharge in inches of runoff

$Q_{P1} = 9450 \text{ cfs} \rightarrow \text{el. } 602.9 \text{ MSL} \checkmark$

Storage @ 602.9 = 2600 Ac-ft ✓

Storage @ 590 = 1600 ✓

$$\text{STOR}_1 = 1000 \text{ Ac-ft} \times \frac{1}{5.1 \text{ SM}} \times \frac{12 \text{ IN}}{640 \text{ Ac-ft}} = 3.68'' \checkmark$$

Step 2c

$$Q_{P2} = Q_{P1} \times \left(1 - \frac{\text{STOR}_1}{19.0}\right) = 9450 \left(1 - \frac{3.68}{19.0}\right) = 7620 \text{ cfs} \checkmark$$

Step 3a

Determine Surcharge height to pass Q_{P2}

$Q_{P2} = 7620 \text{ cfs} \rightarrow 602.0 \rightarrow 2510 \text{ Ac-ft}$

$$\text{STOR}_2 = 910 \times \frac{1}{5.1} \times \frac{1}{53.3} = 3.35'' \checkmark$$

Step 3b

$$\text{Average STOR}_1 \text{ \& STOR}_2 = \frac{3.35 + 3.68}{2} = 3.52'' \text{ Runoff}$$

$$3.52'' \times 5.1 \text{ SM} \times \frac{53.3 \text{ Ac-ft}}{\text{in} \cdot \text{SM}} = 957 \text{ Ac-ft} \checkmark$$

$$957 \text{ Ac-ft} + 1600 \text{ Ac-ft} \checkmark = 2557 \text{ Ac-ft} \rightarrow 602.4 \text{ MSL} \checkmark$$

$$602.4 \text{ MSL} \rightarrow 8900 \text{ cfs}$$

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JOB MA 707

SHEET NO. 7A

OF 18

CALCULATED BY JW

DATE 8/13/80

CHECKED BY JFC

DATE 8/20/80

SCALE _____

2nd ITERATION

$$Q_{p2}' = 9450 \left(1 - \frac{3.52}{19}\right) = 7699 \text{ CFS}$$

$$7699 \text{ CFS} \rightarrow 601.6 \text{ FT} \rightarrow 2500 \text{ A.F.}$$

$$2500 \text{ A.F.} - 1600 \text{ A.F.} = 900 \text{ A.F.}$$

$$900 \times \frac{1}{5.1} \times \frac{1}{53.3} = 3.31'' \text{ RUNOFF (STOR 2')}$$

$$\text{STOR AVG} = \frac{3.52 + 3.31}{2} = 3.42''$$

$$3.42'' \times 5.1 \times 53.3 = 928 \text{ AF} + 1600 \text{ AF} = 2528 \text{ AF}$$

$$\text{ELEV } 602.0 ; Q = 8500 \text{ CFS}$$

3rd ITERATION

$$Q_{p2}'' = 9450 \left(1 - \frac{3.42}{19}\right) = 7749 \text{ CFS}$$

$$7749 \text{ CFS} \rightarrow \text{EL } 601.7 \text{ FT} \rightarrow 2500 \text{ A.F.}$$

$$\Rightarrow \text{STOR 2''} = 3.31''$$

$$\text{STOR AVG} = \frac{3.42 + 3.31}{2} = 3.37''$$

$$3.37 \times 5.1 \times 53.3 = 915 + 1600 = 2515 \text{ AF}$$

$$\text{ELEV } 601.9' ; Q = 8400 \text{ CFS}$$

WITH 42" GATE OPEN

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JOB MA 707

SHEET NO. 7B

OF 18

CALCULATED BY JW

DATE 8/14/80

CHECKED BY JFC

DATE 8/20/80

SCALE _____

TEST FLOOD ROUTING w/ 42" CONDUIT CLOSED

TEST FLOOD (PMF) INFLOW 9450 CFS

$$Q_{p2} = 7620 \text{ CFS (FROM SHT 7, STEP 2C)}$$

STEP 3a

$$Q_{p2} = 7620 \text{ CFS} \rightarrow 601.7' \rightarrow 2500 \text{ AF} - 1600 \text{ AF}$$

$$\text{STOR 2} = 900 \text{ AF} \times \frac{1}{5.1} \times \frac{1}{53.3} = 3.31''$$

STEP 3b

$$\text{STOR AVG.} = \frac{3.31 + 3.68}{2} = 3.50'' \text{ RUNOFF}$$

$$3.50'' \times 5.1 \text{ mi}^2 \times 53.3 \frac{\text{AF}}{\text{in} \cdot \text{mi}^2} = 950 \text{ AF}$$

$$950 \text{ AF} + 1600 \text{ AF} = 2550 \text{ AF} \rightarrow \text{EL. 602.2 MSL}$$

$$\text{ELEV. 602.2 MSL} \rightarrow 8300 \text{ CFS}$$

2ND ITERATION

STEP 2c

$$Q_{p2}' = 9450 \left(1 - \frac{3.50''}{19}\right) = 7709 \text{ CFS} \rightarrow 601.6' \rightarrow 2490 \text{ AF}$$

STEP 3a

$$(\text{STOR 2})' = (2490 \text{ AF} - 1600 \text{ AF}) \times \frac{1}{5.1} \times \frac{1}{53.3} = 3.27''$$

STEP 3b

$$\text{STOR AVG.} = \frac{3.27 + 3.50}{2} = 3.39'' \text{ RUNOFF}$$

$$3.39'' \times 5.1 \times 53.3 = 921 \text{ AF} + 1600 \text{ AF} = 2521 \text{ AF}$$

$$\text{ELEV} = 602.0 \text{ MSL}; \quad Q = 8200 \text{ CFS}$$

WITH 42" GATE
CLOSED

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JOB MA 307
SHEET NO. 7C OF 18
CALCULATED BY JW DATE 8/14/80
CHECKED BY JFC DATE 8/20/80
SCALE _____

1/2 PMF ROUTING W/ 42" GATE CLOSED

1/2 PMF INFLOW = 4725 CFS

STEP 2b

$Q_{P1} = 4725 \text{ CFS} \rightarrow \text{EL. } 598.4$

STORAGE @ 598.4 $\rightarrow 2220 \text{ AF}$

STORAGE @ 590.0 $\rightarrow 1600 \text{ AF}$

$$\text{STOR } 1 = 620 \text{ AF} \times \frac{1}{5.1} \times \frac{1}{53.3} = 2.28''$$

STEP 2c

$$Q_{P2} = 4725 \left(1 - \frac{2.28}{19\frac{1}{2}}\right) = 3591 \text{ CFS}$$

STEP 3a

$Q_{P2} = 3591 \text{ CFS} \rightarrow \text{EL } 597.0 \rightarrow 2125 \text{ AF}$

$$\text{STOR } 2 = 525 \times \frac{1}{5.1} \times \frac{1}{53.3} = 1.93''$$

STEP 3b

$$\text{STOR AVG} = \frac{2.28 + 1.93}{2} = 2.11''$$

$$2.11 \times 5.1 \times 53.3 = 572 \text{ AF}$$

$$572 + 1600 = 2172 \text{ AF} \rightarrow \text{EL } \underline{597.8'}$$

$$Q = \underline{4,200 \text{ CFS}}$$

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JOB MA 707 Granville Reservoir
SHEET NO. 8 OF 18
CALCULATED BY JFC DATE 6/3/80
CHECKED BY JMC DATE 7/21/80
JFC DATE 8/19/80
SCALE _____

	1/2 PMF	PMF
Flood Inflow	4725	9450 cfs
Routed outflow w/gate closed	4200	8300 cfs
Routed outflow w/gate open		8400 cfs
Flood Elev. w/gate closed	597.8	602.0 MSL
Flood Elev. w/gate open		601.9 MSL
Top of Dam	600.7 (low end)	600.7 (low end)
Depth of Overtopping w/gate closed	-2.9'	1.3'
Depth of Overtopping w/gate open		1.2'
Storage at Flood Elev.	2172	2515
Spillway Cap at Flood Elev.	$Q = (3.2)(60)(7.8)^{3/2}$ 4183 cfs	$Q = 32(60)(11.9)^{3/2}$ 7882 cfs
Spillway Cap. at top of Dam	6720 cfs	6720 cfs
Spillway Cap. as a % of routed flood outflow	160%	80%

Breach Analysis -

Assume breach width of 40% Crest length at mid ht.

$$W_b = 0.4 \times 400' = 160' \checkmark$$

y_o = ht from Stream level to pool level at failure - Assume pool at 602 MSL \approx top of dam

use $y_o \approx 106'$ ✓

$$Q_p = 8/27 W_b \sqrt{g} y_o^{3/2} \checkmark$$

$$Q_p = (8/27)(160)(32.2)^{1/2}(106)^{3/2} = 294,000 \text{ cfs} \checkmark$$

Flow over spillway other than breach: 6700 cfs
(Same as antecedent Q)

$$\text{Breach } Q = 294,000 + 6700 = 300,000 \text{ cfs} \checkmark$$

Breach Q

Storage at top of dam - 2,400 Ac-Ft. = S ✓

Reach 1 -

- Rate channel section 3000' downstream of dam site. Note channel contained in narrow gorge with steep channel gradient. Area of new homes 1.5 Mi. d/s. 40' above channel. See Sht 13A

$$\text{Reach Outflow} - Q_{P_2} = Q_{P_1} \left(1 - \frac{V_1}{S}\right)$$

$$V_1 = 1300 \text{ Ac-ft}$$

$$Q_{P_2} = 300,000 \left(1 - \frac{1300}{2340}\right) = 133,333 \text{ cfs}$$

$$133,333 \text{ cfs} \rightarrow 315 \text{ MSL}$$

$$V_2 \approx 700 \text{ Ac-ft}$$

$$\text{Average} - \frac{V_1 + V_2}{2} = \frac{1300 + 700}{2} = 1000 \text{ Ac-ft}$$

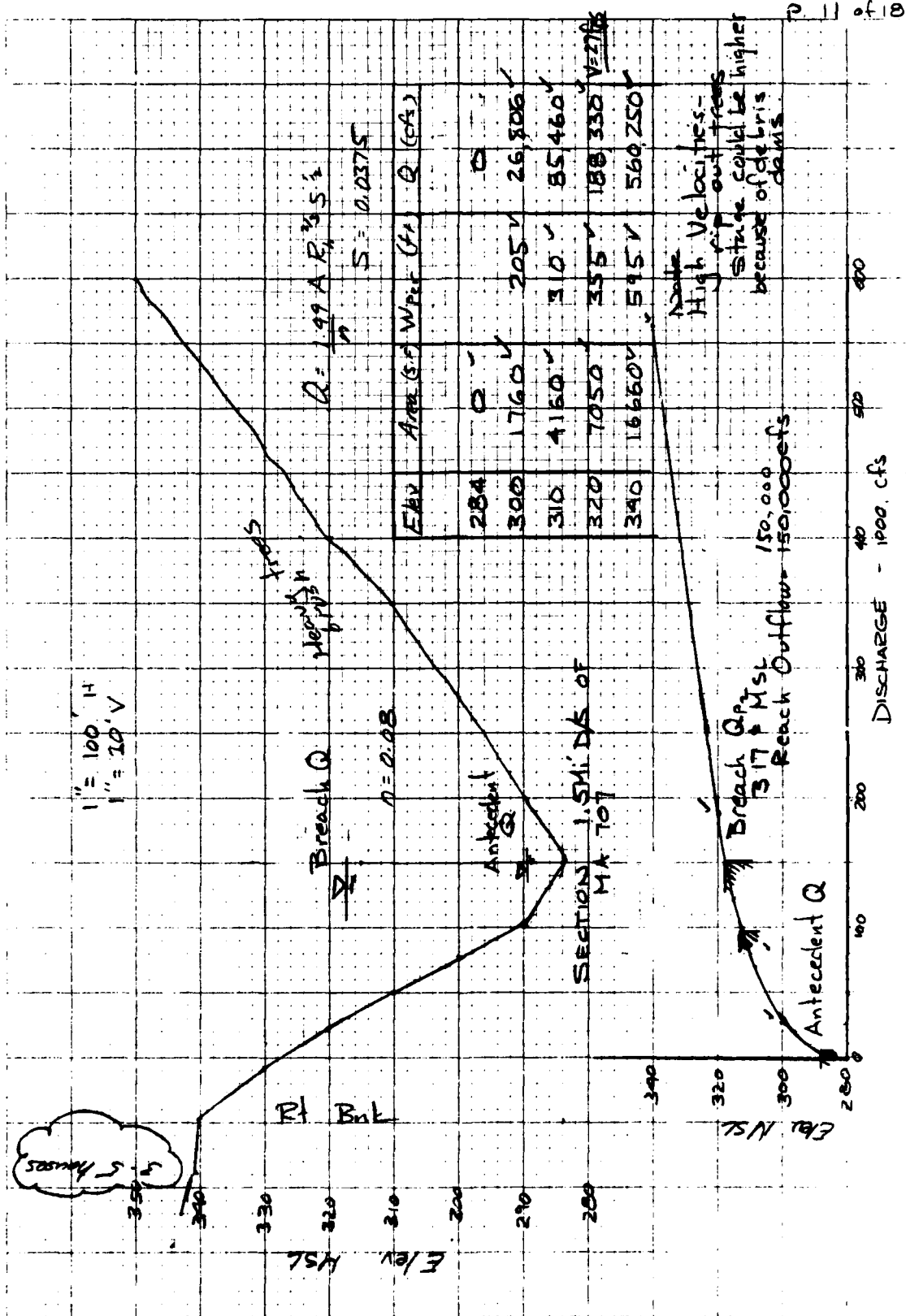
$$\text{Try Stage} \rightarrow 317 \pm \text{MSL}$$

$$\text{Channel Storage} = 6100 \text{ SF} \times \frac{7000 \text{ ft}}{43560} = 980 \text{ Ac-ft} \quad \text{OK}$$

$$\text{Stage about} - 317 \text{ MSL}$$

$$\text{reach outflow} - 159,000 \text{ cfs}$$

Note Stage could be higher due to log jams & debris dams caused by high velocities (25+ fps) of floodwave



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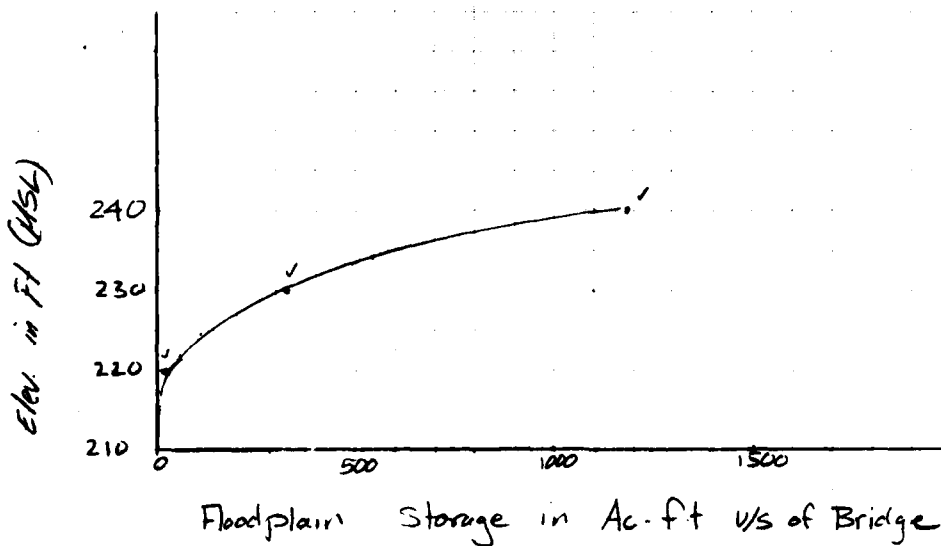
JOB MA 707 Granville Res
SHEET NO. 12 OF 18
CALCULATED BY JFC DATE 6/3/80
CHECKED BY Jmc DATE 7/21/80
SCALE _____

Reach 2 -

- Rate bridge at North Loomis St
16,000' + D/s. of dam site
See Sht 14A

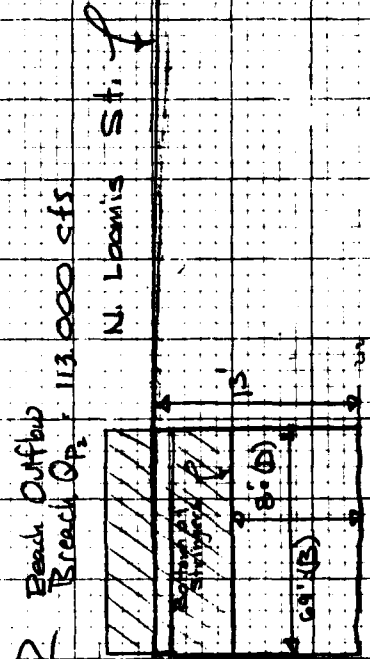
Estimate Flood plain storage upstream of bridge
at Loomis St

Elev	Area Ac	Δ Storage Ac-ft	Σ Storage Ac-ft
220	5 ✓	20 ✓	20 ✓
230	55 ✓	300 ✓	320 ✓
240	120 ✓	875 ✓	1195 ✓



DATE 7/21/80

EDGE AT NORTH LOUIS ST.
3.1 MI. D/S OF SITE
APPROX CROSS SECTION



Antecedent Q =

2' Bank

1" = 50' H
1" = 10' V

Consider opening as box culvert with inlet control
ref: NEH 4 Exhibit 14-6 (2)

Elev.	Flow thru bridge			Flow over road (water)				Q TOTAL (cfs)
	H _w	H _o /D	Q/B	Q'	L	H	q	
212	0			0			0	0
220	8'	1	66	4554				4554
225	13	1.62	110	1590	800	0	0	7590
227	15	1.88	125	8625	900	2	6619	15244
235	23	2.88	165	11385	1000	10	82,219	93,604
240	28	3.5	185	12765	1300	15	196,360	209,125

Elev (Approx MSL)

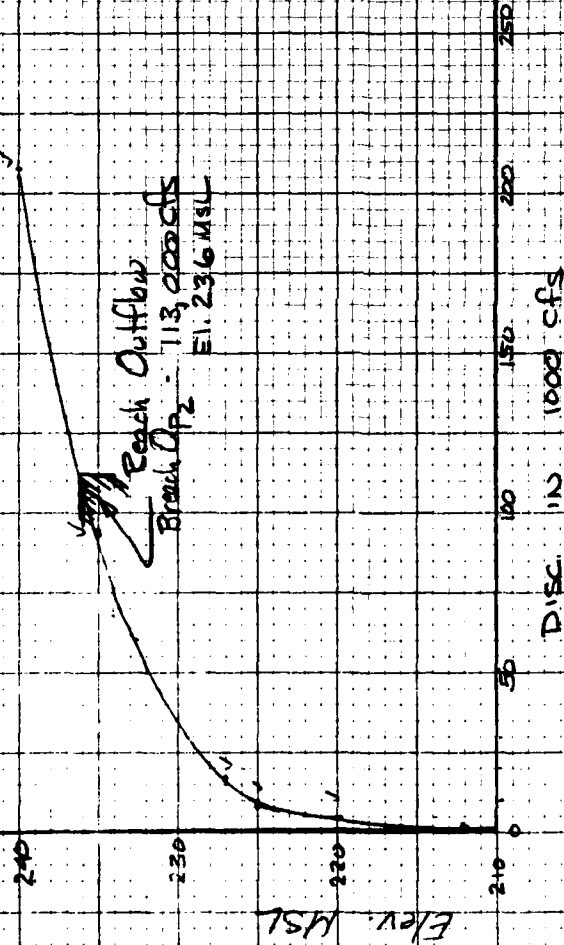
230

220

210

RATING: BRIDGE AT
N. LOUIS ST.
3.1 MI. DOWNSTREAM
OF MA 707

DATE 7/21/80



1/4" = 10' Inch

Compute Breach Q - Reach Outflow below
N. Loomis St.

$$Q_{P_1} = Q_{P_2} \text{ for previous reach} = 150,000 \text{ cfs} \checkmark$$

$$Q_{P_2 \text{ Trial}} \cdot \text{This reach} = Q_{P_2 \text{ prev. reach}} \left(1 - \frac{V_1}{S}\right)$$

from rating curve skt 14b, 100,000 cfs \rightarrow 235MSL \rightarrow 600 Ac-ft

$$Q_{P_2 \text{ Trial}} = 100,000 \left(1 - \frac{600}{2340}\right) = 111,540 \text{ cfs} \checkmark$$

$$\text{for } 111,540 \text{ cfs} \checkmark \rightarrow 236 \text{ MSL} \checkmark \rightarrow 550 \text{ Ac-ft}$$

$$V_{\text{ave}} = \frac{600 + 550}{2} = 575 \text{ Ac-ft} \checkmark$$

$$Q_{P_2} = \text{Reach Outflow below N. Loomis St.} = 150,000 \left(1 - \frac{575}{2340}\right) = 113,140 \text{ cfs} \checkmark$$

Several homes in this area 6-12
would be subject to deep flooding
5 to 10 feet. Floodplain upstream of
N. Loomis Street helps attenuate flood
peak but not enough to prevent
residential flooding.

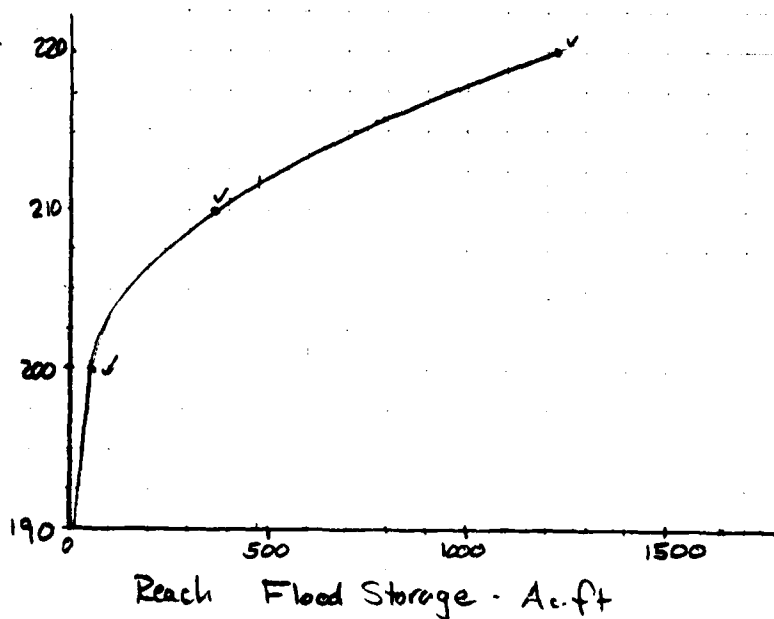
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JOB MA707 Granville Reservoir
SHEET NO. 16 OF 18
CALCULATED BY JFC DATE 6/20/80
CHECKED BY JMC DATE 7/21/80
SCALE _____

Analyze Channel Section 4.2 mi. downstream of
dam site - There are several homes in this
area which are adjacent to Munn Brook.
Beyond this area Munn Brook enters the
floodplain of the Little River.

Estimated Floodplain Storage v/s of this section
Roughly
Estimated
from USGS Quad.

Elev.	Area Ac	Δ Storage Ac-ft	Σ Storage Ac-ft
190	0 ✓		—
200	10 ✓	50 ✓	50 ✓
210	55 ✓	325 ✓	375 ✓
220	115 ✓	850 ✓	1225 ✓



USMC 7/21/80

500 M.S.

5,150 CFS
BREACH Q

ANTICEDMENT
Q

Elev in Feet (454)

Elev's taken from
USGS Quadrangle
Net by Survey

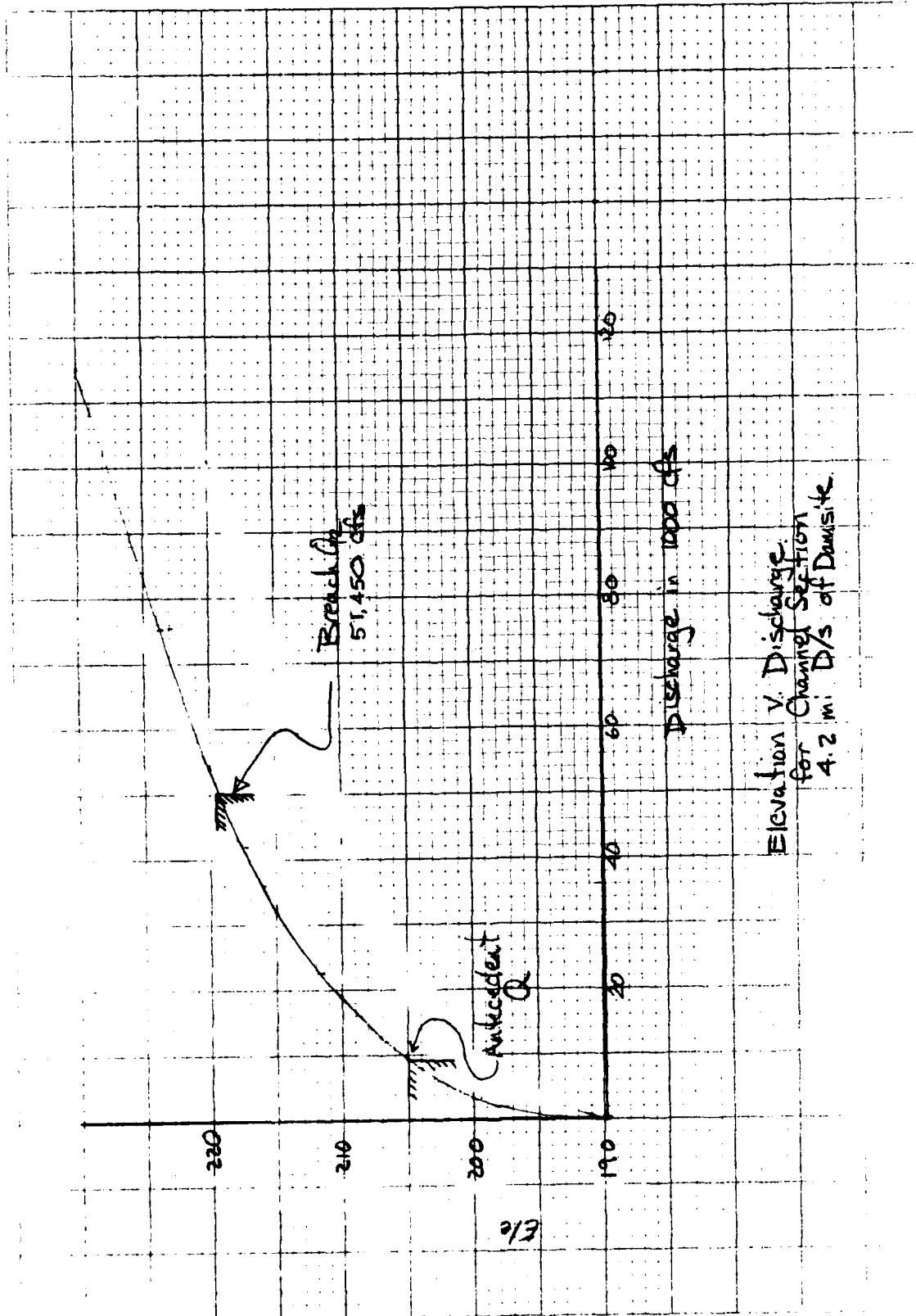
Scale 1" = 200' H
1" = 10' V

Channel Section 4.2 M. D/S
of Damsite

$S = 0.003$
 $n = 0.07$
 $Q = 1.41 AS^2 R^{3/2}$

ELEV.	AREA	Wp	R _h	Q
190	0	-	-	0
200	950	160	5.94	3,645
205	1950	230	8.48	9,487
210	3500	300	11.00	19,027
215	5050	395	12.78	33,292
220	7350	420	15.48	53,781
230	13,200	650	20.37	119,942

Note - New development noted
in floodplain



Compute Reach outflow

$$Q_{P_1} \text{ (previous reach)} = 113,000 \text{ cfs.}$$

$$\text{From p. 17A; } Q_{P_1} \rightarrow 113,000 \rightarrow 228 \text{ MSL} \rightarrow 1,500 \text{ Ac-ft} = V_1$$

$$Q_{P_2}(\text{Trial}) = Q_{P_1} \left(1 - \frac{V_1}{S}\right)$$

$$Q_{P_2}(\text{Trial}) = 113,000 \left(1 - \frac{1,500}{2340}\right) = 49,560 \text{ cfs}$$

$$Q_{P_2 \text{ Trial}} \rightarrow 49,560 \text{ cfs} \rightarrow 218 \text{ MSL} \rightarrow 1,050 \text{ Ac-ft} = V_2$$

$$V_{\text{ave}} = \frac{V_1 + V_2}{2} = \frac{1,500 + 1,050}{2} = 1,275 \text{ Ac-ft}$$

$$Q_{P_2} = Q_{P_1} \left(1 - \frac{V_{\text{ave}}}{S}\right)$$

$$Q_{P_2} = 113,000 \left(1 - \frac{1,275}{2340}\right) = 51,430$$

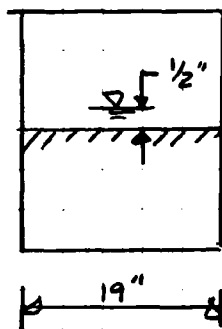
use 51,450 cfs \rightarrow

Note 12-15 homes in this area
subject to flooding 1 to 12 feet
Loss of more than a few lives likely
Previous to breach approx. 5 to 7
of these structures would be flooded
Below this section 7 to 12 additional
structures lie in the floodplain and
would receive flood damage

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JOB HA 707 Granville Reservoir
SHEET NO 18A OF 18
CALCULATED BY JFC DATE 7/24/80
CHECKED BY _____ DATE _____
SCALE _____

Estimated normal seepage over weir for
foundation drain of Dam



$$Q = 3.33 b h^{3/2}$$

$$Q = 3.33 \left(\frac{19}{12} \right) \left(\frac{0.5}{12} \right)^{3/2} = 0.0498 \text{ cfs}$$

$$Q \approx 20.0 \text{ gpm}$$

$$Q = 20 \text{ gpm} \times 1440 \frac{\text{min}}{\text{day}} = 28930 \frac{\text{gal}}{\text{day}}$$

29,000 gal/day Seepage

$$\frac{29000 \text{ gal}}{600 \text{ ft}} \approx 50 \text{ gpd/ft}$$

DISCHARGE CAPACITY OF 24" RESERVOIR DRAIN

$$Q = C H^{1/2}$$

$$C = A \sqrt{\frac{2g}{1 + KY + KPLP}}$$

$$A = 24" \phi = 3.14$$

$$N = 0.012$$

$$KP = 0.01058$$

$$KY = 1$$

$$LP = 600$$

$$C = \sqrt{\frac{2 \times 32.2}{1 + 1 + 0.01058 \times 600}}$$

$$C = 2.77$$

$$Q = 2.77 (106)^{1/2} = 28.5 \text{ cfs} \approx 30 \text{ cfs}$$

APPENDIX E

**INFORMATION AS CONTAINED IN
THE NATIONAL INVENTORY OF DAMS**

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE COUNTY DIST.	CONGRESS COUNTY DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY MO YR
MA	707	NED	MA 013 01		GRANVILLE RESERVOIR DAM	4205.3	7250.5	

POPULAR NAME	NAME OF IMPONDMENT			
	GRANVILLE RESERVOIR			
REGION/BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI.)	POPULATION
01 19	MUNN BROOK	GRANVILLE		0

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCT. HEIGHT (FT.)	HYDRAU. HEIGHT (FT.)	IMPOUNDING CAPACITIES (ACRE-FT.)	MAXIMUM	NORMAL
0508	1928	S	106	106	2400	1650	

DIST OWN FED R PRV/FED SCS A VER/DATE
NED N N N N

REMARKS

U.S. SPILLWAY	MAXIMUM DISCHARGE (CFS)	VOLUME OF DAM (CU)	POWER CAPACITY INSTALLED PROPOSED (MW)	NAVIGATION LOCKS
1 650 11 50	6700			

OWNER	ENGINEERING BY	CONSTRUCTION BY
CITY OF WESTFIELD		

DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE

INSPECTION BY	INSPECTION DATE DAY MO YR	AUTHORITY FOR INSPECTION
ROBERT G BROWN & ASSOC INC	06JUN80	PL 97-367

REMARKS

END

FILMED

7-85

DTIC